

PREPARATION

BATTERIES

The only batteries that are furnished with these plants are for the remote control and some electric start battery charging type. These batteries are of the automotive rubber case type. A complete set of cables is furnished for connecting battery to the plant.

When making the connections be sure that the polarity is observed between batteries be sure to connect the positive (+) post of one battery to the negative (-) post of the other. The positive post of that battery is connected to the negative post of still another. Then the remaining positive (+) post is to be connected to the (+) post on the control panel. The same applies to the negative (-) connection. Reversing these connections would discharge and eventually destroy the battery. Cover the terminals with petroleum jelly.

Check the electrolyte in the cells of the battery. If the battery has been received in a wet charged condition and if the electrolyte is low, add distilled water to bring the solution over the level of the plates. If the battery has been received in a dry charged condition, add electrolyte to the battery according to the instructions attached to it.

In the case of the battery charging plants, the user or operator is to furnish his own batteries. These are commonly of the lead plate type either rubber case or glass jar. Other types of batteries such as the Edison may be charged but it is important to see that the voltage rating of the battery is approximately the same or the same as that of the plant. It is also necessary that in making connections that the polarity markings of both plant and battery is observed.

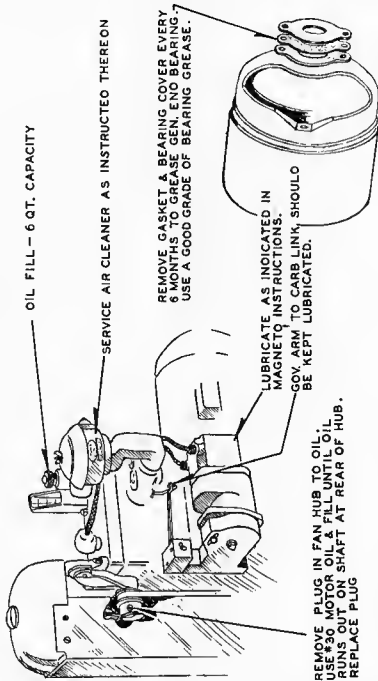
Any batteries used should be handled and charged according to the instructions furnished by the battery manufacturer or supplier. This is especially important with the glass jar type because of their design and use. If these are not available, observe these precautions:

1. Keep all connections tight and clean.
2. Maintain the level of the electrolyte by adding only distilled water.
3. Do not charge at a higher rate than specified for the battery capacity.
4. Do not overcharge the battery or allow to reach too low a state of discharge. As an average the battery can be used between a hydrometer range of 1150 to 1250.
5. Do not allow the battery to stand in a discharged condition.
6. Periodic charging and discharging will prolong the life of the battery.

MAIN LINES

The wiring to which the electrical load is connected should terminate in a disconnect switch of either the fused or circuit breaker type. On the manual plants this is then connected to the wires extending from the generator. On the Remote Control Plants it is connected to the terminals on the control panel.

LUBRICATION



ABNORMAL OPERATING CONDITIONS

COLD WEATHER

Fuel. The fuel tank should always be kept full to prevent condensation within the tank. Under extremely low temperatures strain the gasoline through a chamois skin. Periodically check all filters and screens. Clean thoroughly each time.

Lubrication. Keep temperatures around plant as high as possible.

Crankcase. Run the plant until oil in the engine is warm and then drain the oil. Mix 5-1/2 quarts of SAE 10 with 1 pint of kerosene or any other suitable diluent. Fill the crankcase. Start the plant and run for at least 10 minutes. Do not use a heavier oil or kerosene only.

The oil should be drained after 40 to 50 hours of operation and replaced with a new solution. Oil must be warm before being drained. Under extreme temperatures drain the oil more often to remove water condensation.

Air Cleaner. Replace oil with same as used in crankcase. If that tends to congeal or frost forms to restrict operation of the cleaner, clean and replace dry.

Cooling.

Radiator. Flush thoroughly.

Engine. Flush thoroughly and separately from the radiator.

Hoses. Check all hoses and replace if necessary. Tighten all hose clamps.

Gaskets. Inspect gaskets, especially cylinder head gaskets. Replace gaskets if necessary. Tighten all nuts.

Fan Belt. Inspect fan belt. Adjust or replace.

Anti-freeze. Use an available anti-freeze either alcohol or glycerine base and prepare the mixture according to the manufacturers instructions. Do not mix two different types of anti-freeze together.

Add the mixture to the cooling system, but only to within several inches below the overflow.

Add anti-freeze on the basis of operating temperature. Check daily especially when temperatures change.

Electrical.

Ignition. Inspect spark plugs and breaker points periodically. Keep them cleaned and adjusted.

Batteries. Batteries must be kept fully charged in low temperatures. Discharged batteries will freeze and be damaged beyond repair at about 32°F. Do not add water to a cold battery. The water may freeze before it mixes with the electrolyte. Store battery in a warm place until it can be recharged.

ABNORMAL OPERATING CONDITIONS
HIGH TEMPERATURE

Lubrication. The oil level must be kept at the full mark on the gage. Maintaining a lower level is dangerous as the engine will run hot. Maintaining a higher level is equally dangerous as the oil foams and as a result the parts which are normally spray lubricated receive no oil.

If the engine is in good condition, normal crankcase oil may be used but the crankcases should be drained after each 100 hours of operation. If engine is warm or temperatures are excessively high, it is permissible to use S.A.E. 30 oil.

Cooling. The cooling system should be kept filled with clean soft water, and flushed at regular intervals to remove all rust, scale and foreign matter. Flush block and radiator separately, check often and add water when necessary.

The radiator shell, grille and engine must be kept free from dirt, bugs, leaves or any other matter which would reduce the cooling effect.

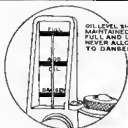
Replace damaged radiator hoses. Tighten all hose connections. Check and adjust fan belt tension. Replace belt if necessary.

Ignition. Keep ignition system adjusted properly at all times. Retarded ignition causes overheating. Advanced ignition reduces efficiency. Check ignition wires and all connections. Keep spark plugs and breaker points clean and adjusted. Keep the engine timed just below the "ping" point.

DUST OR DIRT

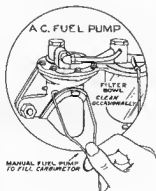
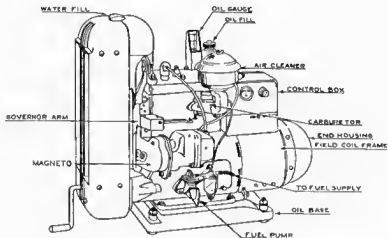
Under adverse conditions it is necessary to check the plant and service it more often as follows.

1. Keep the plant (engine, radiator and accessories) as clean as possible.
2. See that the supplies of fuel and oil are in air tight containers. Strain either if they are dirty.
3. Check the ignition system (breaker points and spark plugs) more often and clean and adjust when necessary.
4. Clean the oil bath air cleaners and refill with fresh oil. Check Daily.
5. Clean brush rig and armature often. See that the brushes ride easily in the holders.



OIL LEVEL SHOULD BE MAINTAINED BETWEEN FULL AND LOW MARK. NEVER ALLOW TO DROP TO DANGER MARK.

ACCESSORY SERVICE SHEET



MANUAL FUEL PUMP
TO FILL CARBURETOR



DO NOT PRESS STARTER BUT-TON CONTINUOUSLY WHILE STARTING - PRESS INTERMIT-TENTLY FOR PERIODS OF ABOUT 5 SECONDS.

OPERATION

STARTING PLANT

CAUTION. See that lubricating oil, fuel and cooling liquid have been added, proper ventilation provided and the plant is properly installed. Open the disconnect switch. See that all of the previous instructions on preparation have been followed.

Electric Start Plants. Press the "start" button and hold down for about five seconds; then release. The plant has an automatic choke so no hand choking is needed. Repeat the procedure after about 10 seconds until the plant starts. If plant does not start, check the fuel and ignition systems and repeat the procedure. In an emergency, if the electric start system is not operating, the plant may be started according to the procedure under "Manual Plants".

OPERATION

Check the panel controls, if any to see that the engine is operating satisfactorily. Then after engine is warm, close the electrical disconnect switch to connect the load. Check engine operation periodically. For the first 10 hours of operation plant should be run at only 1/2 load.

STOPPING PLANT

To stop the plant press the "stop" button on the plant or at the remote station. Hold button down until engine has stopped.

MAINTENANCE

It is important that certain inspections and maintenance procedures be made at definite periods to keep the power plant operating continuously and at a maximum level of efficiency. ~~It is recommended that a service log be kept. If operated under abnormal conditions, check these pages for correct maintenance.~~

DAILY MAINTENANCE

A daily check of the following points should become a matter of routine.

1. Cooling liquid level.
2. Crankcase oil level.
3. Fuel supply - Do not fill tank while plant is running.
4. Inspection of operating gages.
5. Keep the plant clean.

WEEKLY MAINTENANCE

Check each week or after every 50 hours of operation.

OIL. Check the oil and add whatever is necessary to bring the level to the "Full" mark on the gauge. If necessary change oil.

1. In cold weather - change every 50 - 60 hours.
2. In high temperature - change every 100 hours.
3. In average temperature change every 200 hours.

When changing oil, run the plant until it is warm. Then drain and re-fill with new oil. Do not drain when plant is cold.

FAN BELT. There should be $\frac{3}{4}$ " of movement "in" or "out" from the normal position. Adjust if necessary.

WATER. Check the water level and add whatever is necessary. If anti-freeze is used add the correct proportion.

FUEL. Check the strainer either on the fuel pump or tank. Remove bowl and screen and clean both. Replace tightly, and check for leaks.

BATTERIES. If used, check the water level. Add whatever distilled water is necessary to bring the level to $\frac{3}{8}$ " above the top of the plates. Do not fill to the top of the battery.

Check the charge condition with a hydrometer. If the reading is below 1.250 specific gravity increase the charging rate; if above, decrease the charging rate.

CONNECTION. Inspect all electrical connections. See that they are tight and clean.

MAINTENANCE

Monthly Maintenance

Each month or after 200 hours of operation check the following points in addition to those covered in the regular weekly servicing.

Oil - Drain the crankcase while the engine is warm. Replace the plug and refill with 6 quarts of new oil of the proper grade and viscosity.

Air Cleaner - Remove and clean the air cleaner each time the engine oil is changed. Refill with engine oil of the same grade as that used in the crankcase.

Ignition - Manual starting plants have magneto ignition. Remove the cover from the magneto and inspect the breaker points. Clean with 00 sandpaper, a small file, or a fine stone. Adjust the gap. See the magneto instruction page for further details.

On electric starting plants, ignition current may be furnished by 2 six volt coils connected in series, and an external breaker mechanism. Remove the breaker cover and crank the engine until the points are open. Clean the points and adjust to .025".

Spark Plugs - Remove the covers from the spark plug and the plug from the cylinder head. Clean and reset the electrode gap to .025" to .030".

Fuel System - Close the shut-off valve. Remove the bowl and screen from the pump or filter and clean out any sediment. Replace and when the valve has been opened check for leaks.

Cooling System - Check the oil level in the fan hub and add oil if necessary. Be sure that the filler plug is tight.

Generator - Inspect the commutator and collector rings. Clean them if necessary. Check brushes for proper seating and for easy riding in holders. Replace any brushes worn to approximately 5/8" in length.

Six Months' Inspection

At the end of six months of operation, go over all the weekly and monthly maintenance points. In addition, remove the gasket plate from the rear of the generator shaft and clean out all the hardened grease from the bearing. Repack the bearing with not more than one tablespoonful of approved ball bearing grease. Never use cup grease as it will not stand up under this type of operation. Replace the gasket and tighten the gasket plate carefully.

Drain and flush the cooling system. Refill with water or an approved anti-freeze such as alcohol, glycerine, or ethylene glycol in proportions recommended by the anti-freeze manufacturers.

YEARLY ENGINE SERVICING

Each year, if the plant is used under normal conditions, the accumulated hours of operation will total 2500 or more. After each 2500 to 3000 hours, the engine should be given a thorough checking over which will include inspection of pistons, piston rings, valves, bearings, etc.

Valve grinding, accompanied by a thorough cleaning of carbon is one of the most frequently required service operations in a modern gasoline engine. Have the following parts on hand before attempting to grind the valves:

- | | |
|------------------------|----------------------------|
| 1 Cylinder Head Gasket | 1 Carburetor Flange Gasket |
| 1 Cylinder Base Gasket | 1 Set Radiator Hose |
| 1 Water Inlet Gasket | 1 Radiator Inlet Gasket |
| 1 Water Outlet Gasket | 1 Manifold Gasket |

We recommend that a complete set of piston rings, valves, valve springs, locks and guides are on hand in case inspection shows replacement necessary.

To disassemble the engine for valve or piston service, follow the outlined procedure:

1. Drain all water from the radiator and engine.
2. Remove the radiator outlet and inlet.
3. Disconnect fuel line to carburetor.
4. Remove air cleaner and choke assembly.
5. Disconnect governor arm at carburetor.
6. Remove carburetor and intake manifold.
7. Disconnect ignition wires and remove spark plugs.
8. Remove magneto assembly.
9. Remove tappet cover
10. Remove cylinder head nuts and lift cylinder head from the block. (If it sticks, tap the cylinder head sharply with a hammer to loosen. Never pry it off with a pry bar or screwdriver).
11. Remove cylinder bolts and then the cylinder from the base. (When removing, be careful not to let the pistons drop on the sharp edges of the crankcase and become damaged).

Inspect the piston rings carefully. Be sure that any accumulated carbon is removed from the oil groove in the piston rings, and the holes in the pistons. If the rings have considerable tension, are bright and shiny showing a good fit to the cylinder, not worn excessively, and fit snugly in the piston grooves, they may be continued in service. Be careful when removing them to keep them so that they will be replaced in the same order and position as they were.

The cost of new rings is very low and we recommend replacement each time the engine is overhauled. When installing new rings, fit each ring individually to the cylinder for which it is intended. File the ends of the rings slightly if necessary to leave an end gap of approximately .010" when the ring is in position in the cylinder.

Grinding the Valves - To grind the valves, it is first necessary to remove the valve locks from the base of the stems. To do this, compress the springs and pull out the locks. The valves can then be lifted out of their guides.

Check the condition of the valves carefully. If the stems are worn or bent, replace with new ones. If the valve faces are badly pitted they can sometimes be made serviceable again by refacing them on a valve face grinder. However, never use a refaced valve that has a thin edge, as it will warp or burn after a short period of time. In refacing the valve, be sure to get a true 45° angle on the face.

Clean the valve stems and guides of all dirt and carbon. Valve guides that are badly worn can be removed from the block and replaced with new ones. Put a thin coating of a medium grade of valve grinding compound on the face of the valve. Insert the valve in the guide with a thin coil spring over the stem to prevent too much pressure while grinding. Rotate the valve back and forth with a vacuum cup tool, using a light pressure, for several cycles. Then lift the valve, turn it part way in its seat and repeat this oscillating movement. Replace the compound whenever it begins to lose its cutting properties.

Each valve should be ground until a bright silvery band extends entirely around the valve and the seat. Wipe off all the compound and put pencil marks across the face. Pressing and rotating the valve against the seat should erase these marks. Regrind until it will, and a gas tight fit will be assured.

When all the valves have been ground, replace each valve in the seat to which it was ground. Install the springs, washers and locks. Be sure that all traces of carbon have been scraped from the cylinders, piston heads, and cylinder head. Replace the cylinder block, being careful to compress each piston ring to prevent breakage. Be sure to use a new cylinder base gasket. Tighten the block to the crankcase.

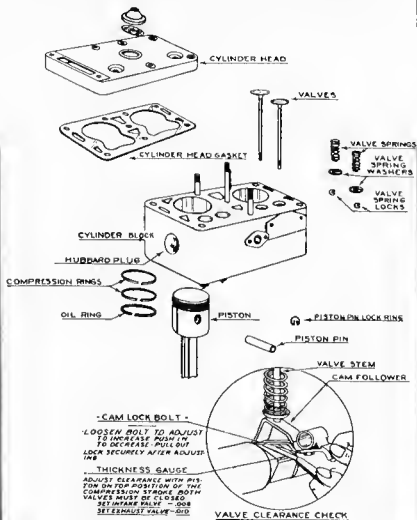
Tappet Adjustment - When the block has been installed and tightened securely, the tappets should be adjusted. Proper clearance between the valve stem and the valve tappet is .006" to .008" for the intake valves and .008" to .010" for the exhaust valves.

Loosen the cap screw locking the tappet lever to its bearing and push the lever as far into the crankcase as possible. A .008" feeler gauge should then be inserted between the camshaft and the face of the cam follower, and the lever pulled back upward until the gauge is squeezed lightly between the cam and the lever face. Make this adjustment on each cylinder when the piston is at top dead center of the compression stroke. When proper adjustment is made, retighten the cap screw securely.

Complete the reassembly of the engine using new gaskets throughout. A great deal of careful work and fine workmanship can be spoiled by trying to reuse old gaskets.

Retighten each of the nuts after the engine has been run for a short time, to be certain that they are all tight.

CYLINDER AND VALVE SERVICE SHEET



MAJOR ENGINE OVERHAUL

After long periods of operation (1 to 5 years or more) it may be necessary to completely overhaul the engine and generator. However, this should not be contemplated unless operation has become inefficient or noises have developed indicating looseness of the bearings, pistons, timing gears or other working parts of the engine.

Crankcase Inspection - Drain the oil from the engine, and remove the inspection plate at the right side of the crankcase. Insert a trouble lamp in the crankcase and by inspecting the general appearance and feeling the fit of the various parts, determine whether a complete overhauling is necessary, and which parts will probably need replacing. Arrange to have these parts on hand, as well as all necessary gaskets before attempting the actual overhauling.

No one unfamiliar with modern internal combustion engines should attempt to overhaul the plant. Disassembly of the engine and generator will follow a natural course. Examine each part as it is removed and decide which must be replaced, which repaired, and which can be adjusted. Replace any part of which you are doubtful. It is poor economy to reuse parts worn to such an extent that they would need replacing before all the others.

Worn or scored pistons, rings, and bearings must be replaced. Worn cylinders can be bored or honed to an oversize diameter, and larger pistons can be furnished by the factory. New connecting rod bearing inserts will restore proper bearing clearances unless the bearing journals have become scored or rough.

Main Bearings - The main crankshaft bearings are not adjustable, but they seldom need replacing. If it becomes necessary to replace them, the bearing caps and bearings or the entire crankcase can be returned to the factory for servicing. If transportation facilities make this inconvenient or out of the question, a line reamer can be set up in a drill press and new bearings reamed to the proper size. Old bearings must be punched out and the new ones set in with the oil groove running in an opposite direction to the rotation of the crankshaft.

Oil Seals - Oil seals are sheet metal and leather units pressed into the rear main bearing and the front gearcase cover. Replace the seals whenever a major overhaul is made, or whenever oil leakage occurs. Be careful not to damage the lip of the seals when installing them. Grease the shaft, tap the seals into position evenly, and shellac the surfaces after the seals are installed.

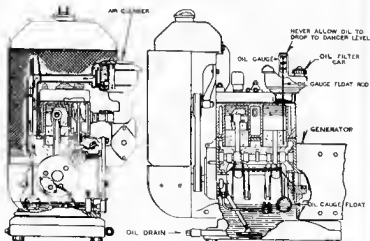
OILING SYSTEM

PLANT IS BOTH PRESSURE AND SPRAY LUBRICATED-OIL IS DISTRIBUTED THRU FRONT MAIN BEARING, THRU THE CRANKSHAFT, THRU REAR MAIN BEARING AND BACK TO THE CRANKCASE

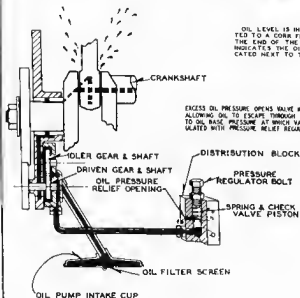
A SOLID FLOW OF OIL REACHES BOTH MAIN BEARINGS AND CONNECTING RODS AT ALL TIMES
PISTON CYLINDER AND OTHER INTERNAL MOVING PARTS ARE LUBRICATED BY SPRAYED OIL METERED THRU THE SIDE CLEARANCE OF BOTH CONNECTING RODS

CRANKCASE IS EFFICIENTLY VENTILATED BY WAY OF THE OIL GAUGE HOUSING AND AIR CLEANER ALL FUMES ARE TAKEN INTO COMBUSTION THRU THE CARBURETOR

THIS SKETCH ILLUSTRATES THE OPERATION OF FULL PRESSURE TYPE GEAR DRIVEN OIL PUMP-
HEAVY BLACK LINES INDICATE THE OIL FLOW



OIL LEVEL IS INDICATED BY A ROD CONNECTED TO A CORR. FLOAT IN THE CRANKCASE- THE END OF THE ROD IS THE POINTER AND INDICATES THE OIL LEVEL ON A MARKER LOCATED NEXT TO THE OIL FILLER CAP



EXCESS OIL PRESSURE OPENS VALVE IN DISTRIBUTION BLOCK ALLOWING OIL TO ESCAPE THROUGH PRESSURE RELIEF OPENING TO OIL BASE PRESSURE AT WHICH VALVE OPENS MAY BE REGULATED WITH PRESSURE RELIEF REGULATING BOLT

Spark Plugs - Champion #M-6 Spark Plugs are furnished as standard equipment with this plant. These plugs are of the proper heat range for this type of unit and replacements when necessary should be of the same make and type or of a comparable type made by some other manufacturer. When removed for cleaning, reset the gap at .025" to .030". Inspect the condition of the porcelain and the electrodes. If the porcelain looks burned or chalky, or if the electrodes are badly burned or worn, replace them. Ordinarily, replacement should be made after 1500 to 2000 hours of operation. This service is comparable to 35,000 to 50,000 miles in an automobile.

Visual tests of spark plug operation:

1. If the insulator is a light brown, operation is satisfactory.
2. If the insulator is a dead white, the plug is too hot or the mixture too lean.
3. If the insulator has a dull sticky deposit, the plug is too cold or the mixture too rich.
4. If the insulator has a shiny black deposit, the plug is too cold or the engine is pumping oil.
5. If the electrodes are burned, the plug is too hot or a poor grade of fuel has been used.

A "hot" plug has a large area of the insulator exposed to the burning gases. A "cold" plug has a small area of the insulator exposed to the burning gases.

Air Cleaner - An oil bath type air cleaner is used on this plant. It should be cleaned each time the engine oil is changed, and if operation is under dusty conditions, clean it oftener.

Remove the cleaner element from the cleaner body and the cleaner body from the carburetor intake. Rinse the element in gasoline until all traces of dirt are gone. Wash all dirt and oil from the cleaner body. Refill the oil reservoir to the proper level, replace the element, and reinstall the cleaner on the engine.

Electric Automatic Choke - On all plants equipped with magneto ignition an electric choke is used. A small heating element inside the choke casting draws current from the exciter windings of the generator and acts on a thermostatic coil which in turn operates the choke butterfly valve. The choke is directly mounted on the butterfly valve shaft and operates in a manner similar to the other type automatic choke.

To adjust the electric choke, loosen the small screw clamping the thermostat housing to the carburetor choke shaft boss and rotate the housing in a clockwise direction to decrease the air mixture or in a counter-clockwise manner to increase it. Retighten the clamp screw securely when proper adjustment has been made.

Timing Gears - The camshaft is driven by helical cut gears from the crankshaft. The camshaft gear is of cast iron with the governor mechanism built in. The crankshaft gear is either of steel or fibra. Under normal conditions of operation, these gears will last a long time, at least until a major overhauling of the plant becomes necessary. Even then, unless the plant has been subjected to abuse, the cast iron camshaft gear should not need replacing. The crankshaft gear will wear more rapidly. It is held in place by a hexagonal nut which must be removed before the gear can be pulled from the crankshaft.

Be sure that the timing marks on the gears are in line before pressing a new gear on the crankshaft. The engine has been designed to operate with the camshaft in a definite relationship to the crankshaft. If the marks are not in line, this relationship will be voided and the engine will run unsatisfactorily if it runs at all.

Insert a piece of newspaper between the teeth of the gears. It should allow the gears to turn without binding. A piece of heavy wrapping paper should not allow the gears to turn. This test will indicate a clearance of from .002" to .005".

It is necessary to remove the engine radiator to reach the timing gears. With the radiator removed, the governor arm should be disconnected from the carburetor and the forward gearcase removed, exposing the timing gears.

Governor Adjustment - Adjustment of the governor should not be effected by replacement of the timing gears. However, if the arm should have become loosened or removed from the shaft it will be necessary to reset it to the correct position.

Insert a screwdriver in the slot in the top of the shaft, and turn the shaft clockwise as far as it will go. With the shaft held in this position, adjust the arm so that the center of the hole in the opposite end is 2-1/16" from the cylinder casting. Make this adjustment with the throttle link disconnected from the governor arm.

If the throttle arm has been loosened from the throttle shaft, reset it at such an angle that the center of the hole in the outer end of the arm is 1-1/2" from the cylinder casting when the butterfly valve is in a closed position. When the throttle link has been connected, check to make sure that the governor arm will not strike the throttle arm or clamp screw when in a closed position. Install the cotter pin in a position that will not interfere with throttle operation.

Set the stop quadrant which limits the movement of the throttle arm in such a position that it will not interfere with the opening or closing of the throttle. With the engine operating at normal temperatures and under no load, turn the stop screw until the engine speed begins to increase. Then turn it counterclockwise about 1/4 turn.

If a hunting condition exists when all other adjustments are known to be correct, change the adjustment of the sensitivity adjusting stud. Normally, the spring is held about 1-3/8" from the shoulder of the governor arm. Increasing this distance reduces the sensitivity, and hunting. Decreasing the distance gives closer regulation. When this adjustment has been changed, the speed must be readjusted by means of the speed adjusting screw.

ACCESSORY SERVICE

MAGNETO - The magneto is provided with two oilers, one on each side of the main housing, so that whichever way the magneto faces the engine, one oiler will always be convenient. Once every two hundred (200) hours of operation, these oilers should be filled to overflowing with Wico or S.A.E. #10 oil. After every 1000 hours of service it is necessary to re-lubricate the cam oil pad. This is done by removing the pad and squeezing and working into it some stringy grease. A summer grade of automobile transmission grease will very closely resemble that used at the factory. Do not use ordinary grease.

TIMING TO IMPULSE SPARK - When the impulse coupling is to be used in timing the magneto to the engine, and in the absence of other information from the engine manufacturer, first remove the distributor cap, then turn the magneto shaft over in the proper direction of rotation until the impulse coupling has been tripped. Note which tower of the distributor cap the distributor arm is nearest and the cylinder to which this tower is connected by the spark plug cable; turn the engine over to top dead center on this cylinder, on the compression stroke, and time the magneto so that the impulse breaks and spark occurs on Top Center mark.

TIMING TO ADVANCE SPARK - Turn the shaft in a direction opposite to its ordinary rotation until the distributor arm is at the tower of the distributor cap to which is connected the spark plug cable leading to No. 1 cylinder. By means of a thin piece of paper between the points, the exact instant of breaker point opening can be determined. At this point, the magneto is in a position where a spark will be delivered to the No. 1 cylinder. Turn the engine over until the advance spark mark on the flywheel is correctly located on the compression stroke of No. 1 cylinder and couple the magneto to the engine.

REMOVAL OF DISTRIBUTOR CAP, GEAR HOUSING, AND DISTRIBUTOR ARM - The distributor cap is removed by wedging out the distributor clips with a screw driver. The distributor arm may then be pulled off the shaft. When replacing the distributor arm, be sure the key lines up with the flat on the shaft, then push in place. When either arm or cap is replaced, be sure the arm does not hit the insert in the cap. The Gear Housing is removed from the machine by loosening the two screws which hold it in place. When replacing the gear housing, make certain the key in the gear shaft of the gear housing lines up with the slot in the rotor shaft, that the distributor arm is in the same quadrant as when removed, and that the rotor shaft has not turned. Make certain the distributor cap and gear housing gaskets are in place.

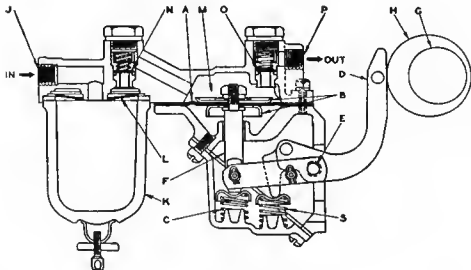
INSTRUCTIONS
TYPE (FM-JFE2) MAGNETOS
FOR RADIO-SHIELDED APPLICATIONS

FIELD SERVICE AND ADJUSTMENT INFORMATION

1. GENERAL DESCRIPTION - Modern ignition systems are carefully engineered to provide quick, easy starting and maximum dependability of operation without adjustment or service. The advanced design and sturdy construction of Fairbanks-Morse Type FM-JF2EB magnetos have established field performance leadership. Especially compact in assembly, the powerful Alnico magnetic rotor assures an intensely hot ignition spark.
2. APPLICATION - Type FM-JF2EB magnetos are built for operation on engines which require complete radio-shielding of the ignition system. Radio-shielding of the magneto is accomplished by enclosing the entire unit in a grounded metal housing, equipped with special ventilating ports. Threaded bushings are provided for connection to the flexible, woven metal sheaths which are used to shield the high tension lead cables. The primary ground terminal is also arranged for connection to a shielded cable on installations requiring a remote control switch.
3. SERVICE PROCEDURE - Field adjustment is rarely necessary and should be undertaken strictly according to the following directions. Before dismantling the magneto, attention should be given the logically arranged service outline in which common causes of engine difficulties are tabulated. In many cases this will prevent unnecessary adjustment of parts in good condition. Simple tests are described in the following discussion which should determine whether the ignition spark is unsatisfactory.
4. TESTING THE IGNITION SPARK - With properly adjusted spark plugs in good condition, the ignition spark should be strong enough to bridge a short gap in addition to the actual spark plug discharge. This may be determined by holding the ignition cable not more than 1/16" away from the spark plug terminal (the top half of the spark plug radio-shield will have to be removed before this test can be made). The engine should not miss fire when this is done.

THE AC FUEL PUMP

SERIES "B", "D" AND "O"



How It Works

By revolving shaft (G) the eccentric (H) will lift rocker arm (D) which is pivoted at (E) and which pulls the pull rod (F) together with diaphragm (A) held between metal discs (B) downward against spring pressure (C) thus creating a vacuum in pump chamber (M).

Fuel from the rear tank will enter at (J) into sediment bowl (K) and through strainer (L) and suction valve (N) into pump chamber (M). On the return stroke, spring pressure (C) pushes diaphragm (A) upward forcing fuel from chamber (M) through pressure valve (O) and opening (P) into the carburetor.

When the carburetor bowl is filled the float in the float chamber will shut off the inlet needle valve, thus creating a pressure in pump chamber (M). This pressure will hold diaphragm (A) downward against the spring pressure (C) where it will remain inoperative until the carburetor requires further fuel and the needle valve opens.

Spring (S) is merely for the purpose of keeping rocker arm (D) in constant contact with eccentric (H) to eliminate noise.

ACCESSORY SERVICE

Fuel Pump - A standard automotive type fuel pump is used. If fuel does not reach the carburetor, check the fuel supply, position of the shut-off valve, fuel lines, and strainer before disassembling the pump. Operation of the pump can be checked by removing the fuel line to the carburetor and working the manual plunger at the side of the pump up and down. If there is a sufficient quantity of fuel in the tank, the shut-off valve open, and the fuel line from the tank to the pump unobstructed, but the pump will not operate, remove the pump from the engine and repair or replace it.

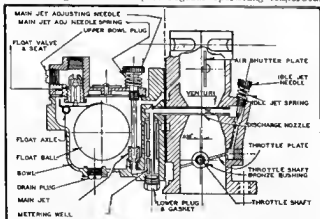
Failure of the pump to operate is usually due to a leaking diaphragm, valve or gasket; a weak or broken spring; or to wear in the driving linkage. Parts and service for this pump can usually be obtained at any garage or service station, or a complete repair kit containing all necessary valves, gaskets and the diaphragm can be supplied for this pump if there is no service station handy.

Removal of the six screws in the top of the pump allows the separation of the pump into two groups the cover group which contains the valves and valve springs, and the pump body group containing the diaphragm and driving linkage.

When reassembling the pump, shellac the edges of the diaphragm to insure an air tight seal. Check the operation of the pump, and check all connections to be sure that there is no leakage.

Carburetor

Little care or attention need be given the carburetor other than an occasional cleaning about once a year to keep the bowl from becoming filled with sediment. However, changes in the type of fuel used or in operating conditions, may cause the plant to run unevenly, and it will then be necessary to readjust the carburetor. Run the plant for approximately one-half hour before changing the adjustment. This will allow the engine to warm up to regular operating temperatures.



If the plant runs unevenly under light load, or no load, turn the Idle Jet needle to the right, into the carburetor body until the engine nearly stops. Then open it slowly to the position at which the engine runs smoothest. Usually from 1/2 to 1-1/4 turns open is the correct setting.

Some carburetors are equipped with an adjustable Main Jet. In others, a non-adjustable jet is used. When the plant operates unevenly under half or full load, the Main Jet will need adjusting. Turn this needle out (counter-clockwise) 4 or 5 turns to enrich the mixture. Then turn it slowly in towards the bowl (clockwise) until the plant begins to lose speed and power. Open the adjustment slowly until the plant regains maximum power and speed. This point will be the correct setting for efficient operation.

At times, the engine will "hunt" (alternately gaining and losing speed.) To correct the condition the Main Jet may be opened slightly more. However, never open the jet over one half turn from the point of efficient operation. A rich mixture would drown out the "hunt", but operation would be uneconomical. Consult the "Governor Operation and Adjustment" pages and decrease the governor sensitivity.

Continued irregular operation, hard starting, or loss of power may indicate that the Main Jet has become clogged. The fuel passage in this jet is very small and if foreign material should get thru the filter screen and bowl, it may lodge in this jet. Remove the float bowl cover, and remove and clean the jet.

When removing the Main Jet, use a screwdriver of the proper size to avoid burring or distorting the jet. Use a stream of compressed air to blow out any obstruction. A wire or anything similar must never be used as the brass is soft and could easily be scratched or enlarged. Be sure that the small fibre gasket is in place below the head of the jet when assembling the carburetor.

SPECIFICATIONS

MECHANICAL DETAILS

ENGINE - The engine is of the two cylinder vertical type with cylinder block separable from the crankcase. It is four cycle water cooled L-Head operating on gasoline. The bore is 3"; the stroke 2-3/4"; the compression ratio 5-1/2 to 1. The cylinder end cylinder heads are cast of nickel alloy iron.

The crankcase is of cast iron and is removable from a cast iron oil base. Inspection covers are fitted to both sides of the case. Main bearings are pressed into the bearing plate, line-reamed and bolted to the end of the crankcase. They are 1-3/4" in diameter, 1-5/16" long and are made of steel backed babbit. The oil filler tube vents the crankcase through a tube to the air cleaner.

The cylinders are removable from the crankcase. They are fitted with pistons having two compression and one oil ring.

The camshaft is supported by steel-backed babbit lined bearings, pressed into the crankcase. They are 1-11/16" in diameter and 1-1/4" long. A cast iron camshaft gear with its integral governor mechanism meshes with a steel crankshaft gear. The governor controls the speed of the engine and generator. Governor adjustment is accessible directly behind the engine radiator.

An oil bath air cleaner is mounted on top of the choke body casting which is bolted to the side of the cylinder block. This is connected by a tube to a conventional type carburetor bolted to the intake manifold. The choke is automatic.

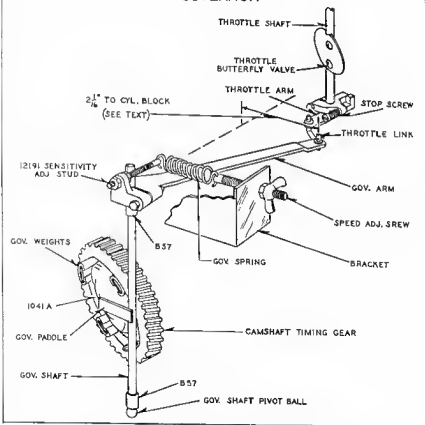
The engine is pressure and spray lubricated having an oil capacity of 6 quarts. A float type gauge is mounted on the oil filler tube. The oil pressure is adjustable.

In the manual plants fuel is supplied to a float type carburetor from a filter bowl on the mounted fuel tank. Other plants are supplied with a fuel pump mounted on the plant. Fuel is pumped from a tank to the carburetor.

Ignition is furnished by a shielded magneto driven by a gear through the gearcase housing. Spark plugs are housed in cast aluminum housings and are connected with high tension shielded cables.

The engine is cooled by a thermo-siphon water system having a capacity of 9 quarts. A pusher type fan driven by a V belt from the crankshaft has a speed of 1-1/10 times the engine speed. It forces the air out end through a radiator mounted in front of the engine.

GOVERNOR



GOVERNOR OPERATION AND ADJUSTMENT

The governor consists of four evenly spaced weights pivoted on the front of the camshaft gear in such manner that as the engine speed increases they tend to fly outward, thus forcing the governor cup forward from the face of the gear. Forward movement of the governor cup moves the governor shaft paddle and rotates the governor shaft, at the top of which is located the governor arm, linked to the throttle arm of the carburetor.

An adjustable spring holds the governor arm against the attempted motion of the governor cup. The balance of force between governor spring and governor weights regulates the engine speed and generator voltage. Increasing the spring tension increases the speed and voltage, and vice versa. The normal speed is approximately 1800 R.P.M. at no load, 1755 R.P.M. at full load. The voltage should not exceed 125 volts at light load.

GENERATOR SERVICE

TESTING FOR A SHORTED FIELD COIL - A shorted or partially shorted field coil can be tested by a meter which will measure the amount of resistance in the field coils. As the amount of resistance should be practically the same in all coils, if one coil shows less than the others, it is a good indication that the coil is shorted. If there are no instruments handy for making this test, a fairly accurate check can be made when the symptoms are first noticed by testing the temperature of the coils before stopping the plant. If one coil is shorted, it will run much cooler than the others, and by feeling the generator frame where the pole shoes are bolted to it, a shorted coil can be located. A shorted coil must be replaced.

TESTING A.C. WINDING OF THE ARMATURE FOR OPEN CIRCUITS OR GROUNDS - Place one end of a test lamp on the outer or insulated collector ring, and the other end on the inner collector ring. If the windings are in good condition, the lamp should light. If it fails to light, the circuit is open.

Place one end of the test lamp on the armature shaft. Touch the other end to the collector rings. If the lamp lights, the winding is grounded.

If the winding is either open, or grounded, the armature must be replaced. Only a competent armature repair service man is qualified to repair an armature, as it will be necessary to have the armature rewound before being serviceable again.

TESTING THE D.C. WINDING OF THE ARMATURE - If one end of a test lamp wire is placed on a clean surface of the armature shaft, the lamp should not light when the other end of the wire is touched to the commutator. If the lamp lights, the commutator or the D.C. windings are grounded, and the armature will have to be replaced.

FILTER CONDENSERS - Filter condenser are mounted inside the generator frame. If one of these condensers should become shorted, no current would be generated. Disconnect the condenser leads, and try the plant. If, with the condensers disconnected, the generator operates satisfactorily, replace the condenser that is faulty. It is necessary that condensers be used in the generator to suppress radio interference. Operation of the plant would be satisfactory without the condensers, but the use of any radio equipment in the vicinity would be impossible if the plant were not shielded against interference.

GENERATOR DISASSEMBLY

Removing the Frame From the Engine - The generator frame is clamped to the rear of the crankcase by four clamp washers and bolts. Before starting to remove the frame, disconnect all line wires or batteries connected to the generator. It is advisable to also remove any accessories mounted on the generator frame such as the control box, if any, gasoline tank, etc.

Raise the generator brushes in their holders until the brush springs slip down the sides, locking them in a raised position. Loosen the four bolts clamping the generator frame to the crankcase, removing the two bottom ones first. When the frame has been unbolted from the engine, support its weight carefully and draw it off over the armature. Do not allow the frame to touch or rest on the armature. The weight of the frame could bend or distort the armature shaft enough to make it unserviceable, if it should be dropped during removal.

GENERATOR SERVICE

POLE SHOES - The pole shoes are made up of laminations of special electrical steel stacked and riveted together, and bolted to the generator frame. They must be removed in order to remove the field coils. When replacing pole shoes, be very careful that all surfaces are clean. An accurate clearance must be maintained between the pole shoes (when assembled in the generator frame) and the revolving armature. Any dirt between the pole shoe and the generator frame would change this clearance and possibly cause damage to the armature. Use lock washers with the bolts, and be sure that they are tightened securely.

BRUSH RIG - It is not necessary to remove the brush rig assembly from the generator frame in disassembly of the generator. If it should have been removed accidentally, or for servicing, line up the mark on the rig with the indicator point on the frame when reinstalling it. Unless the brush rig is in the proper position, excessive arcing of the brushes, heating of the generator armatures and field windings, and low voltage production will result.

REMOVING THE ARMATURE FROM THE ENGINE - The armature is coupled to, and supported by the crankshaft. A draw bolt extending from the crankshaft to a nut at the rear of the armature clamps the armature to a machined surface on the flywheel blower where dowel pins lock it in place. Loosening and removing the nut on the armature thru stud allows the armature to be drawn off over the stud.

Handle the armature carefully. Place it so that it can not roll around or become damaged. The engine flywheel is locked to the crankshaft by a taper and key. When the armature has been removed, a sharp blow at the rim of the wheel will loosen it from the taper, and it can be pulled off the crankshaft.

ARMATURE - The armature is made up of a stack of perforated discs (referred to as laminations) which is pressed onto a shaft. Wire is wound on this stack and the ends are connected to copper bars called a commutator and two brass rings called collector rings. (Direct current is drawn from a commutator and alternating current from collector rings). On this generator, there are both a commutator and collector rings. Windings for both are wound on the same laminations, with the direct current being used to excite the alternator field coils. This makes the unit entirely independent of any outside source of power.

GENERATOR SERVICE

The interior and exterior surfaces of the generator must be kept clean and free from metal dust, dirt, oil and water. A stream of compressed air directed thru openings in the generator frame after the cover has been removed, is the most satisfactory method of removing ordinary accumulations of dirt and dust. Be sure that the air stream is free from oil or water, or the condition will be made worse.

If the interior surfaces of the generator are oily, the generator will have to be disassembled and the parts thoroughly cleaned with a solvent such as gasoline, benzine, or carbon tetrachloride. An oily condition is an indication that the rear main crankshaft oil seal is leaking and needs replacing. Be sure to check the condition of this seal and replace it if necessary, while the generator is separated from the engine.

The following chart has been prepared to assist in locating the most common troubles associated with electric generators and the causes of these troubles.

GENERATOR HEATING

- | | |
|------------------------------------|--------------------------------|
| 1. Overloading | 4. Poor Commutation |
| 2. Shorted coil or coils | 5. Unequal air gap |
| 3. Grounded armature or commutator | 6. Reversed field coil winding |

Note: Any of these conditions cause a large circulating current in the windings to the commutator, to the brushes and the brush connections, and cause an artificial overloading of the armature.

FIELD COIL HEATING

1. Operating Speed Too High with a Resultant High Output Voltage.
2. A Partial Short Circuit of One Coil.

POOR COMMUTATION

- | | |
|---------------------------|---------------------------------|
| 1. Brushes Unevenly Set. | 6. Brush Pressure Insufficient. |
| 2. Brushes Not Fitted. | 7. Brush Pressure Uneven. |
| 3. Brushes Binding. | 8. Wrong Type of Brushes. |
| 4. Brush Spacing Unequal. | 9. Commutator Bars Loose. |
| 5. Worn Brushes. | 10. High Mica. |

FAILURE OF GENERATOR BUILD-UP

- | | |
|------------------------------|---------------------------------|
| 1. Plant Speed Below Normal. | 4. Brush Location Wrong. |
| 2. Reversed Field Winding. | 5. External Short Circuit. |
| 3. Reversed Shunt Field. | 6. Open Circuit in Shunt Field. |

GENERATOR SERVICE

The commutator is probably the most frequent source of generator trouble. If it is very dirty from brush wear, clean it with kerosene. If it is rough or pitted, the armature must be mounted in a lathe and the commutator turned until it is smooth. It will then be necessary to shave or undercut the mica insulation about $1/32$ " below the level of the copper to allow the brushes to ride on the copper bars without interference. Polish the bars carefully and be sure that there are no metal particles in the cuts between the bars. If the plant should be started with metal particles between the bars, the armature windings would burn out.

The commutator should maintain a polished surface. Blackening of all the bars indicates an incorrect brush position. Blackening of groups of bars at regular intervals may be due to the same cause or to poor contacts. Blackening at irregular intervals indicates a rough or eccentric commutator. A severely burned bar or number of bars, plus excessive flashing when the machine is under load, indicates an open circuit in the windings. Use a lint free cloth to keep the commutator clean.

Over a period of time, the copper bars will wear down to the level of the mica insulation. The mica is harder than the copper, and will form ridges which cause the brushes to jump and make poor contact. The brushes will be very noisy, (noisy brushes are always an indication of a rough commutator), and it will be necessary to turn the commutator as described above.

Never use a lubricant on the commutator. The use of any lubricant will only increase commutation difficulties.

REASSEMBLING THE GENERATOR - Reassembly is made by reversing the procedure used in disassembly. Be sure that all parts are clean. Before sliding the armature shaft over the armature thru stud, grease the end surface to keep it from rusting while in service. Check the rear main bearing oil seal to be sure it is functioning properly.

Before installing the frame on the crankcase, remove the bearing cap from the rear of the generator. Clean the bearing surface in the frame and the bearing on the armature shaft. The frame should be installed over the armature very carefully, and the four bolts that retain it tightened gradually and alternately. Never pull one down tight until the others are nearly tight. Repack the ball bearing with ball bearing grease only.

BRUSHES - The brushes must move freely in their holders and make firm even contact with the commutator and collector rings. Always keep an extra set of brushes on hand and replace any brush that is worn to $5/8$ " in length or less. See the illustration on "Care of Commutator and Brushes" for the proper method of seating the new brushes to the commutator.

Brush spring tension must be the same (approximately $15\text{--}1/2$ to $19\text{--}1/2$ oz.) on all brushes, or one brush will carry more than its share of the load. Measure tension with the brush spring raised to a point where the top of the brush is even with the top of the brush holder. Install new springs if the tension is unequal.

When reassembling the generator the brushes must be raised and locked in their holders to prevent them from being broken by the lip of the commutator. If the commutator has been turned in a lathe, the brushes must be sanded to resseat them to the commutator.

Before starting the plant after reassembly has been completed, turn the engine over slowly for several revolutions to be sure that the armature is not binding or striking against the pole pieces. The armature would be spoiled if such a condition should exist when the plant is started.

REMOTE CONTROL SYSTEM

CONTROL PANEL - The control panel contains a Start Relay, a Charge Relay, three spring type terminals to which the remote control wires are connected, and a Toggle Switch for ignition current control. The Start Relay has extremely heavy contacts to enable it to carry the current which the starting battery delivers to the generator starting winding. Remote start-stop switches, connected to the spring type terminals on the panel by three conductor wires, are momentary contact switches. That is, the circuit is closed only while the switch button is held down. The terminals on the panel are numbered 1, 2 and 3. #1 is a common or ground wire.

PROPER STARTING - The proper method of starting any self-starting plant is to close the start button for a period of about five seconds, and release for a second or two. Then if the plant does not continue to run, press the start button the second or third time, holding each time, for about five seconds, until the engine starts and continues to operate.

If after a half dozen or more of these cycles, the plant does not continue to run, investigate the cause. Look for lack of fuel, discharged starting battery, improperly operating choke, or lack of ignition current, loose connections, etc. See Trouble Chart.

REMOTE CONTROLS AND WIRE - Remote control stations should be of the two button, 3 wire, momentary contact type. Do not use regular switches. The wire should be of a #16 size and preferably of the three conductor type. This size will permit remote control operation up to 250 feet.

STARTING CYCLE - When the Start Button is pressed either at the plant or at the Remote Switch, the battery positive current flows through the coil of the start relay, through the Start Button to ground. This completes an electrical circuit which energizes the Start Relay Coil with 12 volt battery current and closes the Start Relay. This carries battery positive current through its contacts to the series winding of the generator field, and thence to the ground.

The generator becomes a motor which cranks the engine. Ignition current is supplied during this cranking cycle from the Start Relay Contacts, and to the Ignition Coil. As the engine reaches running speed and the start button is released, the ignition circuit is switched immediately from the positive side of the battery to the direct current output of the generator which has after reaching normal running speed become a generator, rather than a motor.

The DC output of the generator at the same time, energizes the shunt coil of the charge relay. The charge relay contacts close and the DC current flows through them to the variable charging control rheostat, through the ammeter to the positive post of the battery. This is a charging voltage which will recharge the battery at a rate depending on the setting of the charging control rheostat. This rate can be varied from a minimum of about $2\frac{1}{2}$ to a maximum of more than 10 amperes.

STOPPING CYCLE - When the stop button at the plant or at a remote start-stop switch is pressed, the D.C. current supply to the ignition coil is by-passed around the ignition coil to the ground, causing the plant to stop because of lack of ignition current.

As the machine is decreasing its speed during the stopping cycle, the magnetism of the Charge Relay is being reduced or neutralized by current flowing through the Series coil of the same relay. When the energy of the two coils becomes equal, the spring on the relay opens the breaker points, breaking the circuit between the battery and generator, to prevent the battery current from passing back through the generator to discharge the battery. This Charge Relay is what is common known as a cut-out and can be compared to an over-size, heavy-duty cut-out similar to those used on ordinary automotive generators.

All wires leading from the generator to the control system and the control system to the ignition system, are color-coded or numbered. If for any reason it becomes necessary to disassemble any of these parts, note the position of the various wires before disconnecting so that no confusion will result when the unit is reassembled.

SERVICING - It is not necessary to provide any regular servicing for the electrical control system. However, it is advisable to inspect the start relay contacts occasionally to determine whether they have become burned or pitted in operation. If this is found to be the case, the contact points should be cleaned carefully with 00 sandpaper.

DIRECT CURRENT CIRCUIT - For emergency or special use a separate direct current circuit may be connected to the battery terminals on the control panel. This circuit should be wired according to the code and should have a fused main switch. No more than about 50 to 75 watts should be taken from this circuit.

When using this circuit be sure to increase the charging rate going into the 12 volt starting battery. This is necessary so that the battery will always be charged enough to start the plant when it is needed. Increase the rate only a small amount and check the battery every day until the rate is sufficient to keep the battery correctly charged. Do not increase it too much as the battery will be overcharged and its life shortened.

EMERGENCY STARTING WITH DEAD BATTERY

ELECTRIC STARTING PLANTS - It is necessary to have the battery connected to the plant whenever attempting to start the unit. However, the battery may be disconnected at any time after the plant is started. The ignition circuit obtains its current from the D.C. output of the generator when the plant is in operation.

It is possible to start a plant even though the battery is almost totally discharged and without enough power to crank the plant. Open the control box cover. At the rear of the control panel will be found a small toggle switch marked "Off" - "On". Under normal operating conditions, this switch is always left in the "Off" position. When the battery does not have enough power to crank the machine, the toggle switch should be turned to the "On" position. This connects the ignition coils directly to the battery which will have enough power to operate them but not crank the engine. Crank the engine by hand and when the plant starts the switch is turned back to the "Off" position.

Low batteries indicate that (1) they have not been properly checked, (2) the charging rate is too low, (3) too much electricity is being used from the D.C. circuit (4) connections are loose or the relay is not functioning properly.

SPECIFICATIONS

ELECTRICAL DETAILS

GENERATOR - Standard Alternating Current Generators are of the four pole type. The armature is directly coupled to the crankshaft by a draw bolt extending from the crankshaft, thru the hollow armature shaft to a nut at the other end. Studs on the flywheel flange prevent the armature from twisting.

All generators are forced air-cooled by a blower mounted at the engine end of the generator. The outboard end of the armature is carried in a grease sealed ball bearing which requires attention once each six months.

This generator produces both Alternating and Direct Current. Both armature windings are on the one rotor shaft. The Direct Current is used to provide excitation for the Alternator Field Coils. In addition, on the electric start plants only, the direct current winding is used to (1) crank the engine for starting purposes and (2) charge the starting batteries.

An extremely large commutator and two collector rings at the ball bearing end of the armature pass DC and AC current through carbon brushes. All of the generator windings are impregnated with insulating varnish and baked. The generator frame is a rolled steel ring, machined inside. Armature laminations are 26 gauge silicon steel and the pole piece laminations are 22 gauge silicon steel.

The generator is condenser and radio shielded to prevent normal radio interference. All generators operate at a maximum 40 degree Centigrade temperature rise. Voltage regulation is close from no load to full load due to the inherent design of the generator.

The speed of the engine and generator is maintained at 1800 R.P.M. for the 60 cycle plants. The rated output is ~~250~~ amperes, 3000 watts, ~~250~~ volt, 60 cycle alternating current.

19-0

230

GENERAL TROUBLES

BEFORE CHECKING FURTHER FOR TROUBLES BE SURE THAT ALL WIRING IS PROPERLY INSTALLED, AND THAT PLANT HAS BEEN SERVICED WITH PROPER GRADE OF FUEL AND OIL.

1. ENGINE FAILS TO START OR IS HARD TO START:
 - (a) Heavy Load on Plant from Motors, Appliances, etc.
 - (b) Too Heavy Oil, Thickened due to drop in Temperature.
 - (c) Fuel Tank Empty - Low Grade of Fuel used.
 - (d) Air Lock in Fuel Line.
 - (e) Improper Fuel Mixture - Air Cleaner Clogged.
 - (f) Defective Ignition.
 - (g) Defective Magneto (See Magneto Service in Maintenance Section).
 - (h) Spark Plug Fouled - Too large or small Gap - Porcelain Cracked.
2. ENGINE STARTS, BUT DOES NOT CONTINUE RUNNING:
 - (a) Overheated - Poor Ventilation.
 - (b) Piston Sticking - Excessive Carbon deposit.
 - (c) Air Lock in Fuel System. Air Vent Clogged.
 - (d) Dirt, Water or Ice in Fuel System.
 - (e) Heavy Load on Plant from Motors, Appliances, Etc.
 - (f) Defective or Shorted Stop Button.
 - (g) Short Circuit on Line. Defective Motors or Appliances.
 - (h) Faulty Ignition - Breaker Arm Sticking.
3. PLANT START, BUT DOES NOT PRODUCE CURRENT:
 - (a) Open Line Wire or Switch.
 - (b) Defective Panel Wiring, or hook up.
 - (c) Blown fuses.
 - (d) Brushes Stuck in Holders and not touching commutator.
 - (e) Brushes worn too low and not seating properly. (See Generator Section).
4. PLANT RUNS TOO HOT:
 - (a) Spark advanced or retarded.
 - (b) Exhaust Back-up - Improper discharge.
 - (c) Improper Ventilation (See Installation Section).
 - (d) Air Cleaner "Too Dirty".
 - (e) Low Oil Level or Improper Grade for Climatic Conditions.
 - (f) Water Level Too Low in Cooling System.
 - (g) Carburetor Mixture too Rich.
5. PLANT USES EXCESSIVE AMOUNT OF OIL:
 - (a) Oil not changed often enough - Dirty Oil (See Lubrication Section).
 - (b) Too Rich a mixture, causing excessive Cylinder Wear - Check Oil Level.
 - (c) Piston Rings Stuck, due to improper Lubrication, overheating or defective Plugs.
 - (d) Engine Overheated, due to poor ventilation.

ENGINE SERVICE DIAGNOSIS

LACK OF POWER

- | | |
|--|---|
| 1 Low or Poor Compression | 4 Air Cleaner Restricted |
| 2 Ignition System Defective
See "Magneto Section" | 5 Low Octane Fuel |
| 3 Carburetor not Functioning
Properly - See "Fuel" System | 6 Overheating - See "Cooling
System" |
| | 7 Improper Grade Viscosity of Oil |

POOR COMPRESSION

- | | |
|-----------------------------------|---|
| 1 Incorrect Valve Clearance | 7 Piston Rings Broken, Worn or Stuck |
| 2 Valve Stems or Lifters Sticking | 8 Piston or Rings Improperly Fitted |
| 3 Valve Stems or Guides Worn | 9 Piston Ring Grooves Worn |
| 4 Valve Springs Weak or Broken | 10 Cylinder Scored or Worn Excessive-
ly |
| 5 Valve Timing Incorrect | |
| 6 Cylinder Head Gasket Leaking | |

EXCESSIVE CYLINDER AND PISTON WEAR

- | | |
|---|--|
| 1 Improper Grade & Viscosity of Oil | 6 Piston Rings not properly fitted
to Piston Groove & Cylinder Wall |
| 2 Lack of Oil | 7 Piston Rings Stuck in Piston
Grooves or Broken |
| 3 Dirty Oil | 8 Air Cleaner not Clean, Allowing
Dirt to Enter Combustion Chamber |
| 4 Overheating - See "Cooling System" | 9 Carburetor Fuel Mixture Too Rich |
| 5 Piston Improperly Installed and
Fitted | |

CRANKSHAFT BEARING FAILURE

- | | |
|--|--|
| 1 Crankshaft Bearing Journal
Out of Round | 6 Bearings Improperly Fitted |
| 2 Crankshaft Bearing Journal Rough | 7 Bearings Loose in Crankcases |
| 3 Crankshaft Oil Passage Restricted | 8 Crankshaft or Bearings Out
of Alignment |
| 4 Bearings Sprung | 9 Lack of Oil |
| 5 Bearings Loose | 10 Low Oil Pressure |
| | 11 Improper Grade & Viscosity of
Oil |

CONNECTING ROD BEARING FAILURE

- | | |
|----------------------------|--------------------------------------|
| 1 Crankshaft Surface Rough | 6 Loose in Connecting Rod |
| 2 Restricted Oil Passage | 7 Bent Connecting Rod |
| 3 Bearings Sprung | 8 Lack of Oil |
| 4 Bearings Loose | 9 Low Oil Pressure |
| 5 Improperly Fitted | 10 Improper Grade & Viscosity of Oil |

BURNED VALVES AND SEATS

- | | |
|---|---|
| 1 Improper Valve Clearance | 7 Improper Type Valves - Use Genuine
parts |
| 2 Weak Valve Springs | 8 Valve Head Too Thin Causing Hot Sac-
tions |
| 3 Improper Valve Timing | 9 Fuel Mixture Flow Restricted |
| 4 Late Ignition Timing | 10 Valve Seats Too Narrow |
| 5 Excessive Carbon Deposits
Around Seat & Valve Head | 11 Overheating - See "Cooling System" |
| 6 Valves Sticking in Guides | |

VALVE STICKING

- | | |
|--|-------------------------------------|
| 1 Incorrect Valve Clearance | 4 Valve Stems Scored or Dirty |
| 2 Inefficient Clearance Between Valve Stem and Guide | 5 Valve Lifters Sticking |
| 3 Valve Springs Weak or Broken | 6 Use of Fuel with High Gum content |

OVERHEATING

- | | |
|-------------------------------------|---|
| 1 See "Cooling System" | 5 Ignition System Defective - See "Magneto Section" |
| 2 Improper Grade & Viscosity of Oil | 6 Valve Timing too Early |
| 3 Fuel Mixture too Lean or Rich | |
| 4 Air Cleaner Restricted | |

EXCESSIVE OIL CONSUMPTION

- | | |
|--|--------------------------------------|
| 1 Piston Rings Broken, Worn or Stuck | 7 Overheating - See "Cooling System" |
| 2 Piston Rings Improperly Fitted | 8 Improper Grade & Viscosity of Oil |
| 3 Piston Ring Slots Clogged with Carbon | 9 Excessive Oil Pressure |
| 4 Cylinder Bore Out of Round or Excessive Taper | 10 Oil Level too High |
| 5 Cylinder Bore Scored or Badly Worn | 11 Oil Leaks at Gaskets and Seals |
| 6 Crankshaft & Connecting Rod Bearing Worn or Excessive End Play | |

LOW OIL PRESSURE

- | | |
|---|--|
| 1 Improper Grade & Viscosity of Oil | 5 Oil Pump Gear to Housing Clearance Excessive |
| 2 Oil Pressure Relief Valve Stuck | 6 Oil Pump Worn Excessively |
| 3 Oil Pump Screen Clogged | |
| 4 Excessive Crankshaft & Connecting Rod Bearing Clearance | |

POPPING, SPITTING & SPARK KNOCK

Pinging or Spark Knock-Caused by Ignition Being Advanced Too Far.
Popping or Spitting - Retarded or Late Ignition

- | | |
|---|---|
| 1 Defective Ignition System - See "Magneto Section" | 6 Exhaust Valve Head Too Thin Causing Hot Spots |
| 2 Carburetor Not Properly Adjusted - See "Fuel System" Section | 7 Excessive Carbon Deposits in Combustion Chamber |
| 3 Valve Clearance Adjusted too Close | 8 Valves Not Seating Properly |
| 4 Weak Valve Springs | 9 Valve Timing Early |
| 5 Hot Spot in Cylinder Head, Usually Caused by Clogged Water Passages | 10 Piston & Rings in Poor Condition |
| | 11 Inferior Grade of Fuel |

INSTRUCTIONS FOR ORDERING PARTS FOR
THIS PLANT

If the following instructions are followed when ordering parts or requesting information on this plant, it will greatly speed up the handling of your order, and help us in rendering prompt and efficient service.

When ordering parts BE SURE to specify ONAN Plant Model No. _____
Serial No. _____.

The Model and Serial Number of your ONAN PLANT will be found on the nameplate located on the side of the Generator Frame.

Parts must be ordered by PARTS NUMBER and by DESCRIPTION in full as given in Parts List. DO NOT ORDER PARTS IN SETS. ALWAYS give exactly the quantity of each part desired.

If in doubt as to the part or parts needed, send the broken or worn part to us by Parcel Post. Write your name and address plainly on the outside and inside of the package so that it can be identified when received.

Write, stating what part or parts you are returning and the purpose for which it is being returned, regardless of previous correspondence. Better still, glue your letter (which must bear a three cent stamp) to the outside of the package. DO NOT SEAL THE PACKAGE.

All parts will be held until letter of advice is received.

PLEASE DO NOT ORDER PARTS in a letter in which some other subject is treated.

SEND YOUR ORDER FOR PARTS TO -

D. W. Onan & Sons
39 - 57 Royalston Avenue
Minneapolis, Minnesota

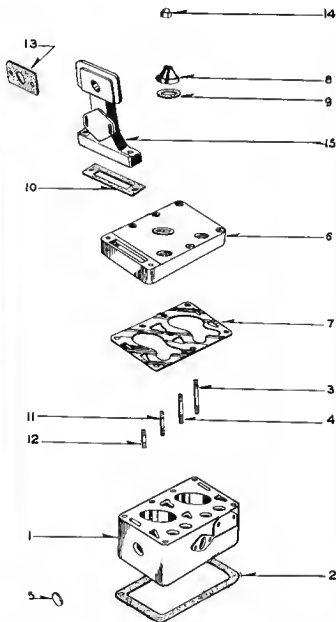
State definite shipping instruction - Express, Freight or Parcel Post when ordering.

EXAMINE SHIPMENTS IMMEDIATELY ON RECEIPT for damage or shortages.

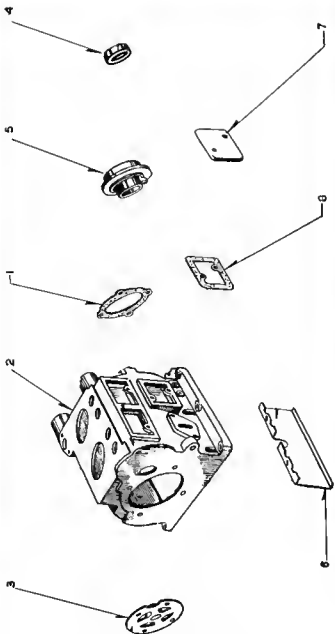
All shipments are complete, properly packed and in good order when delivered to the transportation company.

When a damaged shipment is received, claims should be filed immediately against the transportation company from whose hands shipment has been taken. All claims for shortage or errors in packing must be made immediately upon receipt of shipment, and must be accompanied by the original invoice or packing slip with the proper notation of damage or shortage signed by the transportation company at destination.

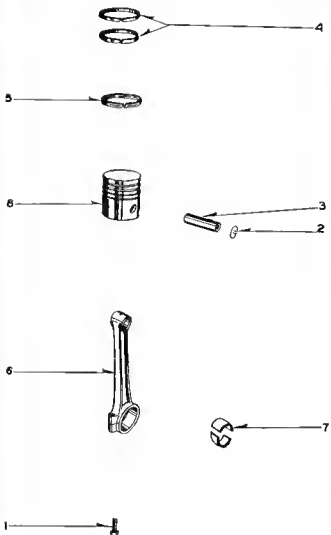
Parts prices quoted herein are F.O.B. Factory at Minneapolis, Minnesota and are subject to change without notice.



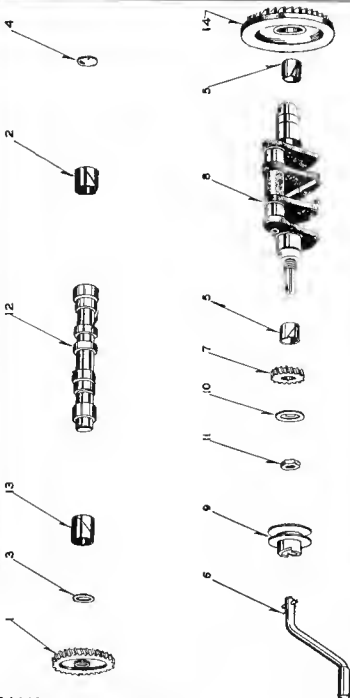
CYLINDER & WATER OUTLET GROUP



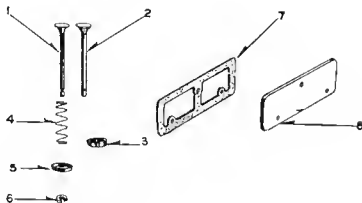
CRANKCASE GROUP



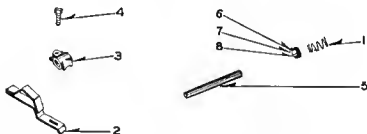
PISTON & CONNECTING ROD GROUP



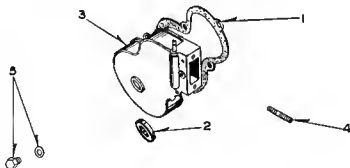
CAMSHAFT CRANKSHAFT & FLYWHEEL GROUP



VALVE GROUP



VALVE LIFTER GROUP



GEARCASE GROUP

INSTALLATION

The proper installation of the plant is absolutely necessary for satisfactory and continuous service. Location, ventilation and temperature are among the main factors to consider.

LOCATION - The plant should be located centrally with respect to the electrical equipment it is to operate. This allows the use of small size current carrying wires, the equipment operates more satisfactorially, and the entire system is more efficient.

If the plant is to be operated as a portable unit it should be protected against extreme exposure to the elements. If used outdoors in extremely cold weather, extra precautions are necessary to provide each starting and proper lubrication of the engine.

If permanently installed in a mobile vehicle, the location should be such that there will be proper ventilation and means for exhausting the gases. The plant should be insulated so that mechanical noises and slight vibration will not affect the operation of other equipment or the personnel aboard the vehicle.

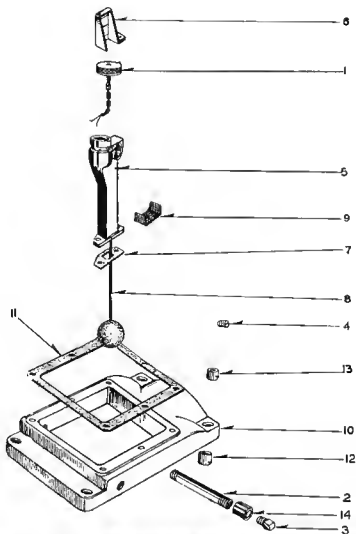
VENTILATION - This is an important factor because overheating will reduce the efficiency of the plant and may result in some serious damage.

Any gasoline engine generates a great deal of heat so that ample means must be provided to remove that heat as otherwise the plant may be damaged. If the plant is permanently mounted, the enclosing room should be at least 10 feet by 10 feet large, and the plant at least 24" from any wall. Air discharge openings should be directly in line with and at least 1-1/2 times the size of the engine radiator. Air inlets should also be the same size. Both openings should be shielded with a screen and louvers. A stack or cupola built in the roof will help to dissipate the heat when the plant is shut down.

When installed aboard a mobile vehicle, the mounting compartment should be as large as possible and at all times the plant should be at least 24" away from any wall. Air inlets and outlets should also be provided as above, and a stack in the roof and openings in the floor will help.

In extremely cold weather, it is possible to control the temperature of the room or compartment in which the plant operates by simply closing a portion of the discharge openings. In this way, a normal temperature can be maintained in a room even though the temperature outdoors might be as low as -30 degrees.

The plant should not be installed where the air is extremely humid, but if this condition cannot be avoided, frequent inspection of the parts which are exposed to the air, particularly the generator and control units of the plant, should be made to insure that humidity is not causing detrimental corrosion and failure of electric plants to operate. These plants are impregnated, plated and otherwise guarded against corrosion as far as humanly possible but corrosion cannot be overcome entirely.

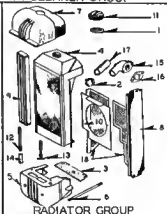
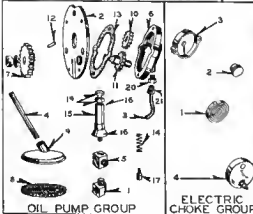
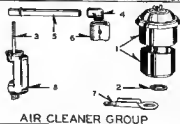
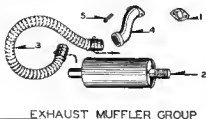
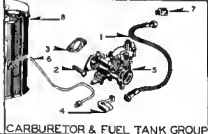
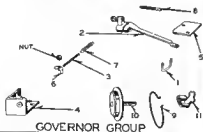
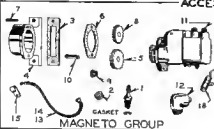


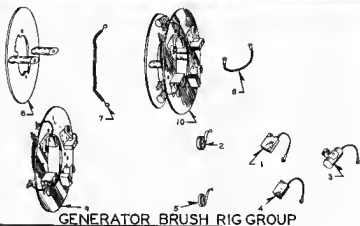
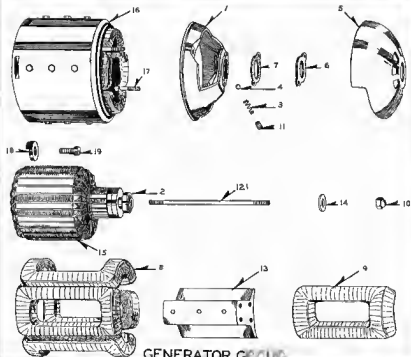
OIL SUPPLY & MOUNTING GROUP

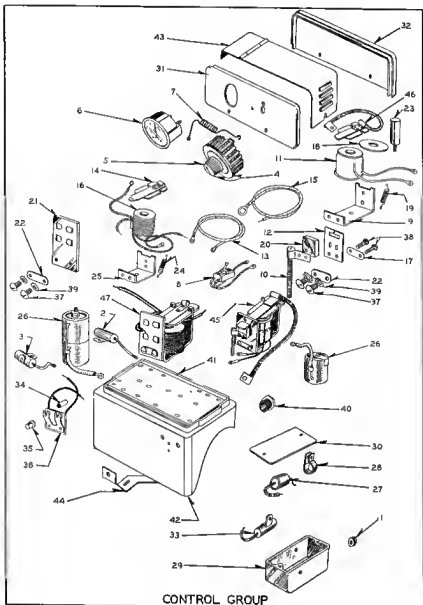


FAN GROUP

ACCESSORIES







CONTROL GROUP

ENGINE PARTS

NO.	PART NO.	DESCRIPTION	QUAN.	PRICE
			USED	EACH
<u>Cylinder & Water Outlet Group</u>				
1	2200L	Cylinder Block.....	1	\$ 20.00
2	2201	Cylinder Block Base Gasket.....	1	.30
3	2202	Cylinder Block Stud - 7/16" x 7-7/8"....	1	.30
4	2203	Cylinder Block Stud - 7/16" x 7-3/4"....	1	.30
5	2206	Cylinder Block Hubbard Plug - 1-1/4" OD.	1	.05
6	2210L	Cylinder Head - 3".....	1	7.50
7	2211	Cylinder Head Gasket - 3" Bore.....	1	.85
8	2212	Cylinder Head Cap - C.I.....	1	.35
9	2213	Cylinder Head Cap Gasket.....	1	.10
10	2216	Cylinder Head Water Outlet Gasket.....	1	.15
11	2217	Cylinder Head Stud - 7/16" x 3-3/4"....	1	.25
12	2218	Cylinder Head Stud - 7/16" x 2-1/2"....	1	.25
13	2223	Rad. Water Inlet Gasket.....	1	.10
14	10183	Cylinder Head Stud Cap Nut - 7/16"....	1	.10
15	12223	Engins Water Outlet.....	1	2.50
<u>Crankcase Group</u>				
1	2007	Rear Main Bearing Plate Gasket.....	1	.25
2	12004	Crankcase - Complete with Bearings.....	1	50.00
3	12005B	Bearing Plate - Front - with Bearings....	1	2.75
4	12009	Crankcase Oil Seal - R.M.B. #50269 Ntl..	1	1.00
5	12010	Rear Bearing Plate.....	1	3.50
6	12011	Crankcase Oil Baffle.....	1	.40
7	12021	Crankcase Inspection Plate.....	1	.50
8	12022	Crankcase Inspection Plate Gasket.....	1	.15
<u>Piston & Connecting Rod Group</u>				
1	508	Connecting Rod Cap Screw - 5/16" x 1-3/4"	4	.10
2	609	Piston Pin Lock Ring.....	4	.05
3	2121	Piston Pin.....	2	.50
4	2122	Compression Ring - 3/32" x 3".....	4	.40
5	2124	Oil Ring - 3/16" x 3".....	2	.50
6	12047	Connecting Rod.....	2	3.75
7	12049	Connecting Rod Insert.....	4	.50
8	12057B	Piston & Pin Assembly Less Rings.....	2	5.50
<u>Camshaft, Crankshaft & Flywheel Group</u>				
1	504	Camshaft Gear.....	1	3.75
2	523	Camshaft Bearing - Rear.....	1	.65
3	527	Spacer Washer - Camshaft Gear.....	1	.20
4	529	Camshaft Rear Bearing Plug - 2".....	1	.05
5	1835	Crankshaft Bearing - Front & Rear.....	2	.75
6	5533	Crank - Manual Starting.....	1	1.25
7	12008	Crankshaft Gear - Steel.....	1	3.25
8	12012	Crankshaft.....	1	14.00
9	12043	Fan Pulley & Crankdog.....	1	2.50
10	12044	Crankshaft Gear Washer.....	1	.20
11	12045	Crankshaft Gear Nut.....	1	.20
12	12050	Camshaft.....	1	6.50
13	12051	Camshaft Front Bearing.....	1	.70
14	12561X	Flywheel & Blower.....	1	6.50

ENGINE PARTS

<u>NO.</u>	<u>PART NO.</u>	<u>DESCRIPTION</u>	<u>QUAN.</u> <u>USED</u>	<u>PRICE</u> <u>EACH</u>
<u>Valve Group</u>				
1	542	Valve - Intake.....	2	.80
2	543	Valve - Exhaust.....	2	.80
3	544	Seal - Exhaust Valve.....	2	.50
4	545	Valve Spring.....	4	.15
5	546	Valve Spring Retainer Washer.....	4	.05
6	547	Valve Spring Retainer Washer Lock.....	4	.05
7	12027	Valve Inspection Plate Gasket.....	1	.30
8	12106	Valve Inspection Plate.....	1	1.25
<u>Valve Lifter Group</u>				
1	528	Cam Follower Spring.....	4	.15
2	760A	Cam Follower Assembly.....	4	.65
3	758	Bearing - Cam Follower - Cast Bronze.....	4	.45
4	761	Cam Follower Screw - 1/4" SAE x 3/4"		
		Hex. Head.....	4	.05
5	2015	Cam Follower Shaft.....	1	.95
6	2016	Cam Follower Spacer Bushing - 7/8"		
		Long.....	As Required	.10
7	2017	Cam Follower Spacer Bushing -		
		19/32" Long.....	As Required	.10
8	2018	Cam Follower Spacer Bushing - 1/16"		
		Long.....	As Required	.10
<u>Gearcase Group</u>				
1	1036	Gearcase Cover Gasket - 1/32".....	1	.30
2	12092	Gearcase Oil Seal.....	1	.50
3	12100A	Gearcase - Magneto Mounting.....	1	4.50
4	12107	Stud - Gearcase to Magneto Drive		
		Gearcase.....	1	.05
5	12152A	Gearcase Inspection Bolt & Copper		
		Washer.....	1	.10
<u>Oil Supply & Mounting Group</u>				
1	1092	Oil Filler Cap - 1/2" x 3.....	1	.50
2	5562	Oil Drain Nipple - 1/2" x 3.....	1	.25
3	10703	Pipe Plug - 1/2" - Oil Drain.....	1	.15
4	10715	Pipe Plug - Oil Gauge Hole.....	1	.05
5	12028A	Oil Filler Neck & Tube Assembly.....	1	2.75
6	12029A	Oil Level Indicator Assembly.....	1	.35
7	12030	Oil Filler Neck Gasket.....	1	.10
8	12031A	Oil Level Float Assembly.....	1	.40
9	12037	Oil Filler Screen.....	1	.10
10	12060	Oil Base - C.I.....	1	12.00
11	12061	Oil Base Gasket.....	1	.40
12	12062	Mounting, Engine - Rubber - 1/2" ID		
		X 1-1/2" OD x 1-7/8" Lower.....	4	.20
13	12063	Mounting, Engine - Rubber - 1/2" ID		
		X 1-1/2" OD x 1" Upper.....	4	.20
14	75858	Oil Drain Coupling - 1/2".....	1	.15
<u>Fan Assembly Group</u>				
1	12251	Fan Support Bracket.....	1	.75
2	12906	Fan Belt.....	1	1.25
3	12255A	Fan Assembly - Complete.....	1	7.50
4	12255B	Fan Pulley Assembly - No. Blades.....	1	4.00
5	12256	Fan Blade Only.....	1	4.00

ACCESSORIES

REF. NO.	PART NO.	<u>Magneto Group</u>	QUAN. USED	'PRICE EACH
5	12097	Magneto Drive Gear.....	1	2.75
6	12101	Magneto Drive Gearcase Gasket.....	1	.15
7	12107	Magneto Drive Gearcase Stud.....	2	.10
8	12108	Magneto Drive Idler Gear.....	1	1.75
9	12109	Magneto Drive Idler Gear Bushing.....	1	.60
10	12110	Magneto Drive Idler Gear Shaft.....	1	.35
11	12138	Magneto - Complete with Shieldings - FM-JFE2-69.....	1	35.00
12	12317A	Spark Plug Shield Assembly.....	2	.75
13	12408	High Tension Cable - Shielded #1.....	1	.40
14	12409	High Tension Cable - Shielded #2.....	1	.40
15	12410	High Tension Cable Clamp.....	2	.10
	12965	Magneto Breaker Point Set.....	1	1.20
16	12975	Magneto Condenser.....	1	1.95

Fuel Pump Group

1	511	Fuel Eccentric Follower.....	1	.90
2	656	Fuel Pump - A.C. #152186.....	1	6.50
3	657	Fuel Pump Gasket.....	1	.15
4	658	Fuel Pump Glass Bowl.....	1	.25
5	747	Fuel Pump Primer Lever - #1522280 AC.	1	.25
6	748	Fuel Pump Primer Lever Cover Gasket - #855229.....	1	.10
7	751	Fuel Pump Filter Screen.....	1	.20
8	659	Fuel Pump Glass Bowl Gasket - #854003	1	.10
9	2019	Fuel Pump Eccentric Follower Shaft...	1	.45
10	400X4	Inverted Male Elbow - Weatherhead....	1	.20
	750	Fuel Pump Diaphragm Replacement Kit #751 A.C.....	1	.75
	749	Fuel Pump Rocker Arm.....	1	1.00

Governor Group

1	12115	Governor Arm to Carburetor Link.....	1	.25
2	12180	Governor Arm.....	1	1.50
3	12186	Governor Adj. Screw.....	1	.15
4	12187	Governor Adj. Screw Bracket.....	1	.35
5	12189	Governor Spring Cover.....	1	.20
6	12191	Governor Spring Stop Stud.....	1	.15
7	12193	Governor Spring.....	1	.20
8		Wing Nut Governor Adj. - 1/4 x 20....	1	.10
9	549	Governor Weight Retaining Wire.....	1	.20
10	1041A	Governor Cup Assembly.....	1	.65
11	2084	Governor Weight.....	4	.40

Carburetor & Fuel Tank Group

1	648	Fuel Line - Flexible.....	1	1.25
2	737	Bolt - Carburetor Flange - Intake Manifold Stud.....	1	.10
3	5656	Gasket- Carburetor Flange.....	1	.10
4	12129	Throttle Shaft Arm - C24-42.....	1	.75
5	12160D	Carburetor - Downdraft - Zenith TU3YH	1	13.50
6	12165	Fuel Line - Pump to Carburetor.....	1	.80
7	400X4	Inverted Male Elbow.....	1	.20
8	649	Fuel Tank - 5 Gal. Round.....	1	3.50

ACCESSORIES

REF. NO.	PART NO.	DESCRIPTION	QUAN. USED	PRICE EACH
<u>Exhaust Muffler Group</u>				
1	2226	Exhaust Muffler Gasket.....	1	\$.10
2	2380	Muffler Only.....	1	3.50
3	2382	3' Exhaust Tubing with Coupling & Nipple Welded on Ends.....	1	2.50
4	12140	Exhaust Outlet Adapter.....	1	1.25
5	12412	Exhaust Outlet Adapter Stud.....	2	.10
<u>Air Cleaner Group</u>				
1	12118	Air Cleaner Assembly - 4-1/2" 2XB- 451 Donaldson.....	1	3.50
2	12121	Air Cleaner Gasket - Armstrong Cork	1	.10
3	12122	Air Cleaner Stud.....	1	.15
4	12132	Adapter for Vapor Trap.....	1	.60
5	12133	Breather Tube.....	1	.50
6	12134	Breather Vapor Trap.....	1	.60
7	12159	Air Cleaner Support.....	1	.75
8	12945	Air Cleaner Adapter.....	1	.85
<u>Oil Pump Group</u>				
1	10697	1/8" Pipe Elbow - 400X4 - Weather- head.....	1	.25
2	12005B	Front Bearing Plate - with Bearings	1	2.75
3	12074	Oil Line - Copper - 1/4" x 5".....	1	.60
4	12077	Oil Pump Suction Pipe - 1/8" x 5-1/8".....	1	.15
5	12079	Pipe Tee - Weatherhead - 3600 X2...	1	.40
6	12080A	Oil Pump Body & Idler Gear Shaft...	1	2.25
7	12081B	Oil Pump Drive Gear.....	1	2.00
8	12084	Oil Pump Screen.....	1	.30
9	12085	Oil Pump Intake Cup.....	1	.80
10	12086	Oil Pump Gear - Driven.....	1	1.25
11	12087A	Oil Pump Gear - Driver with Drive Shaft.....	1	1.75
12	12088	Special Pin - Oil Pump.....	1	.15
13	12089	Oil Pump Body Gasket.....	1	.05
14	12272	Oil Pump Pressure Relief Spring....	1	.10
15	12273	Oil Pump Pressure Relief Block.....	1	2.25
16	12274	Oil Pump Pressure Relief Deflector Cup.....	1	.50
17	12275	Oil Pump Pressure Relief Valve - 5/16" OD x 17/32" M.S.T.....	1	.25
18	12277	Oil Pump Assembly - Does not include 1, 3, 5, 14, 15, 16, 17, 20 or 21..	1	11.50
19	12276	Oil Pump Pressure Relief Bolt - 3/8" x 3/4" SAE - Hex. Head with Lock Nut	1	.25
<u>Electric Choke Group</u>				
1	2170	Thermoetat Element.....	1	.75
2	19922	Choke Shaft Knob.....	1	.35
3	19928	Bracket for Automatic Electric Choke	1	.40
4	19929A	Electric Choke Element & Cover Assembly.....	1	1.50

ACCESSORIES CONT'D

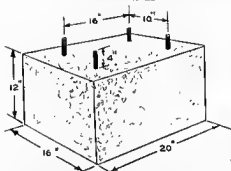
REF. NO.	PART NO.	DESCRIPTION	QUAN. USED.	PRICE EACH
<u>Radiator Group</u>				
1	2265	Radiator Cap Gasket.....	1	.10
2	2268	Radiator Hose Clamp - 2".....	1	.10
3	12209	Radiator Bottom Gasket.....	1	.35
4	12210	Radiator Core & Tank Assembly.....	1	35.00
5	12211	Radiator Base.....	1	6.50
6	12212	Radiator Base Mounting Stud.....	2	.40
7	12213	Radiator Top.....	1	5.50
8	12214	Radiator Side Panel.....	2	1.90
9	12215	Radiator Grille.....	1	1.25
10	12216	Radiator Fan Shroud.....	1	1.90
11	12217A	Radiator Cap Assembly.....	1	1.60
12	12219	Radiator Drain Nipple - 1/8" x 5"....	1	.15
13	12220	Radiator Drain Cock - #185.....	1	.50
14	12221	Radiator Drain Coupling.....	1	.10
15	12222	Cylinder Water Inlet.....	1	1.25
16	12225	Inlet Adapter Gasket.....	1	.10
17	12226	Radiator Hose - 1-5/8" x 5-1/8".....	1	.40
18	12228	Radiator Fan Guard.....	2	3.15
<u>Battery Ignition (Not Illustrated)</u>				
	1745	Battery Positive Cable - 3'.....	1	.90
	1746	Battery Negative Cable - 3'.....	1	.90
	1747	Battery Jumper Cable - 6-3/4' long..	1	.50
	1748	Battery Hydrometer.....	1	.75
	75861	Battery - Grant 13A-6V.....	1	7.50
<u>Generator Group</u>				
1	1260	Generator Bearing Support.....	1	5.00
2	1261	Armature Ball Bearing.....	1	3.00
3	1262	Armature Ball Bearing Lock Spring...	1	.10
4	1263	Armature Ball Bearing Lock 5/16"		
		Steel Ball.....	1	.05
5	1265	Generator End Bell Housing.....	1	3.50
6	1266	Generator Bearing Plate.....	1	.25
7	1267	Generator Bearing Plate Gasket.....	1	.15
8	2595	Field Coil Set.....	1	20.00
9	2596	Field Coil Only.....	4	5.00
10	10183	Cap Nut for Armature Thru Stud - 7/16" SAE.....	1	.10
11	10715	Pipe Plug for Generator Ball Bearing Lock - 1/8".....	1	.05
12	12501	Armature Shaft Thru Stud.....	1	.50
13	12508	Pole Shoe.....	4	3.50
14	12514	Armature Shaft Thru Stud Washer.....	1	.05
15	12515F3S	Armature Ass'y. - With Bearing.....	1	65.00
16	12600B	Generator Frame Assembly - less Armature.....	1	65.00
17	12622	Generator Frame Stud.....	4	.10
18	12623	Generator Frame Clamp Washer.....	4	.15
19	12802	Generator Frame Clamp Screw - 7/16" x 1-1/2" Allen Hd.....	4	.10

GENERATOR CONT'D

REF. NO.	PART NO.	DESCRIPTION	QUAN. USED	PRICE EACH
<u>Generator Brush Rig Group</u>				
1	841	D.C. Brush - #46 - 7/8".....	4	.65
2	842	D.C. Brush Spring - Heavy.....	4	.25
3	5928	Condenser - .1 MFD - R.H. #10289.....	2	.50
4	19652	A.C. Brush - L51 - 5/8".....	4	.55
5	19653	A.C. Brush Spring - Light.....	4	.25
6	12672	Brush Rig Spider.....	1	1.75
7	12677	Brush Connector Lead - A.C. #10 Rockbestos - B.W.B Wire 9-3/4" Long..	1	.20
8	12679	Lead - Condenser to A.C. Brush - 3-1/4" - #14 - 2 Looq. Braid.....	2	.15
9	12682A	Brush Rig Assembly - Complete less Spider.....	1	10.25
10	12683A	Brush Rig Assembly - Complete with Spider.....	1	12.00
<u>Control Group</u>				
1	1053	Rubber Grommet - (Filter Box).....	1	.10
2	1219	Condenser - Filtering.....	1	.75
3	1220	Condenser - Filtering.....	1	.75
4	1412A	Charg's Rheostat - 2 Ohm Model J - Ohmite - Complete.....	1	2.50
5	1412B	Charg's Rheostat Knob.....	1	.10
6	1412C	Charg's Ammeter - 10-0-10.....	1	2.50
7	1412F	Resistance Unit Wire - 5 Turns.....	1	.50
8	1422A	Ignition Toggles Switch Assembly.....	1	.75
9	1426	Start Relay Frame Only.....	1	.95
10	1428A	Start Relay Contact Screw & Strsp...	1	.35
11	1430	Start Relay Coil Only (P.S.1579).....	1	1.25
12	1431	Start Relay Frame Insulator Panel....	1	.40
13	1438	Start Relay to Control Panel Cables...	1	.15
14	1446A	Charg's Relay Armature & Blads Assembly	1	.80
15	1447	Charg's Relay to Control Panel Lead...	1	.15
16	1448A	Charg's Relay Coil & Core Assembly (P.S. 1065).....	1	1.50
17	1483	Reinforcing Strip for 1522.....	1	.05
18	1513	Fibre Insulator Washer - 1-1/2" O.D..	1	.10
19	1517	Start Relay Armature Return Spring...	1	.10
20	1522	Start Relay Armature Blads Lower Contact.....	1	.35

2 CYLINDER WATER COOLED PLANT BASE

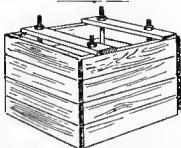
CONCRETE BASE



Above base dimensions are a minimum and may be larger. Keep same bolt spacing. The base must be at least 24" from any wall.

Use 4 - $\frac{3}{8}$ " x 8" bolts. See that they extend 4" above the top of the concrete.

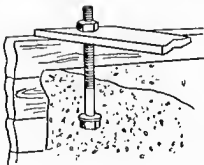
CONCRETE FORM



A form should be built into which the concrete can be poured and allowed to harden.

A mixture of 1 part cement, 2 parts sand and 4 parts gravel or crushed stone may be used. Fill form, tap down but do not move bolts. Allow to harden for three days.

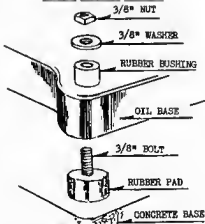
MOUNTING BOLT SUSPENSION



Suspend mounting bolts from cross cleats nailed to the top of the concrete form before pouring concrete. Place large washer under head of bolt and adjust for proper height - 4".

Be sure top of foundation is level and smooth to prevent plant base breakage.

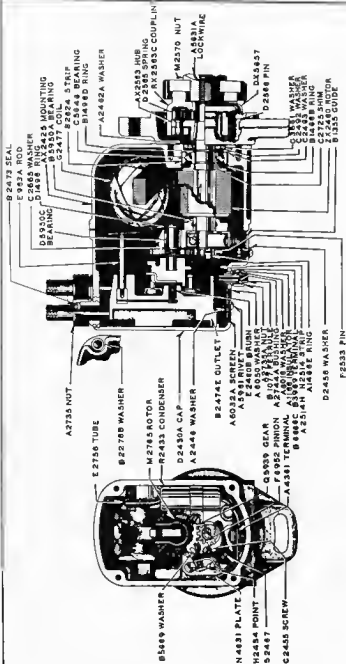
RUBBER BUSHING DETAILS



Use the rubber mounting bushing supplied with the plant. Place one bushing between plant and boss so that bushing fits in recess in plant. Set Plant in place. Assemble balance of mounting as shown above. Tighten nuts but not so that bushings flatten or compress.

Control Group Cont'd.

REF. NO.	PART NO.	DESCRIPTION	QUAN USED	PRICE EACH
21	1553A	Charge Relay Control Panel.....	1	.80
22	1554	Reinforcing Strip for Insulating Panel #1553A-86431.....	1	.05
23	1566	Start Relay Coil Core.....	1	.35
24	1630	Charge Relay Armature Return Spring.....	1	.10
25	1646	Charge Relay Frame Only.....	1	.95
26	1804	Radio Filter Choke - Control Panel	2	.75
27	1805	Radio Filter Choke - Filter Box	1	.75
28	1806	Choke Mounting Bracket - Filter Box.....	1	.25
29	1819	Stop Lead Filter Box.....	1	.25
30	1819C	Stop Lead Filter Box Cover.....	1	.05
31	5301	Control Box Side Panel - Rheostat Side.....	1	5.00
32	5302	Control Box Side Panel.....	1	1.25
33	5928	Condenser - Filter Box.....	1	.50
34	8739	Start-Stop Panel Spacer.....	1	.05
35	8740	Start-Stop Switch Button.....	1	.15
36	8743A	Plant Start-Stop Switch Assembly.	1	.65
37	10414	Machine Screw - R.H.....	1	.01
38	10420	Machine Screws for #1522.....	2	.01
39	10616	Shakeproof Lockwasher.....	1	.01
40	10780	Bushing - Threaded - Metal.....	1	.15
41	12795	Control - Sub Panel Micerte.....	1	1.50
	12795A	Control Panel Assembly.....	1	15.00
43	12803	Control Unit Cover.....	1	1.25
44	12804	Control Unit Base Clamp.....	1	.35
42	12800	Control Unit Base.....	1	4.00
45	12820	Start Relay Assembly.....	1	5.00
46	12821	Start Relay Armature & Blade Assembly.....	1	1.10
47	12822	Charge Relay Assembly - Complete..	1	4.50



TYPE FM-JFE 2B69 MAGNETO

REPAIR PRICE LIST FOR TYPE FM-JFE 2B69 MAGNETO

PART NO.	DESCRIPTION	NO. USED	PRICE EACH
E983A	Distributor High Tension Lead Rod.....	1	\$.15
B1077	Ground Cable Outlet Ferrule.....	1	.15
A1077A	Cable Outlet Blank Washer.....	2 per doz.	.10
A1166	Ground Cable Terminal Insulator.....	1	.10
B1355	Ground Switch Strip Guide.....	1	.15
D1498	Distributor Shaft Snap Ring.....	1	.10
B1498B	Rotor Bearing Snap Ring.....	1	.10
B1498D	Rotor Shaft Snap Ring.....	1	.10
A1498E	Rotor Shaft Pinion Snap Ring.....	1	.10
B2276B	End Cap Screw Washer.....	4 per doz.	.20
AX2425	Frame (or Housing) Flange Mounting - Includes (2) Field Lamination Assemblies.....	1	6.75
D2430A	End Cap - Radio Shielded - Includes A2735 (2), A1077A (2), A2744A (1), A6032A (3), A6030 (6), A5961 (3), A2448 (3).....	1	10.50
10SL4A	End Cap Screw - #10-24 x 7/8".....	4 per doz.	.10
10LW2	End Cap Screw Lockwasher - #10.....	4 per doz.	.10
R2433	Condenser Assembly - Includes Lead Wire and Terminal Screw #A4361.....	1	1.20
BS5N	Condenser Mounting Screw - #8-32 x 5/16".....	1 per doz.	.10
SLW3	Condenser Mounting Screw Lockwasher - #8.....	1 per doz.	.10
S2437	Breaker Arm, Stationary Bracket & Contact Point Set - Includes Breaker Arm, Breaker Arm Spring, Contact Point, Breaker Arm Lead, Breaker Arm Contact Point Washer, Cam Felt Wick #E2768 and Stationary Bracket with Point #H2454.....	1	1.95
A2448	Ventilating Screen Locking Washer.....	3 per doz.	.10
H2454	Stationary Bracket with Contact Point - Includes Bracket, Primary Insul. Bushing, Primary Insul. Washer, Primary Contact Screw Bushing, Primary Contact Screw Washer, Primary Contact Insulator, Primary Contact Point.....	1	.65
BS5N	Stationary Bracket Mtg. Screw - #8-32 x 5/16".....	1 per doz.	.10
SLW3	Stationary Bracket Screw Lockwasher - #8.....	1 per doz.	.10
G2455	Stationary Bracket Eccentric Adjustment Screw.....	1	.15
G2457A	Primary Ground Screw Bushing.....	1	.10
D2458	Spacer Washer.....	1 per doz.	.10
B2460B	Coil Lead Brush - In pairs only (Includes coil Lead Spring).....	1 per Pr.	.30
B2473	High Tension Cable Socket Rubber Seal.....	2	.15
B2474E	Distributor Block Cable Outlet - Includes Cable Outlet Insert, (2) and High Tension Lead Assy.....	1	4.25
BS9N	Distributor Block Screw - #8-32 x 9/16".....	4 per doz.	.10
SLW3	Distributor Block Screw Lockwasher - #8.....	4 per doz.	.10
G2477	Coil Assembly - Includes Coil Winding, Secondary Lead, Secondary Lead Shield, Tape, Coil Lamin- ation Assy., Coil Primary Lead Wire, Lead Wire Tube #E2736 and Lead Wire Terminal #A4361.....	1	6.50
25SS12A	Coil Bridge Set Screw - 1/4-20 x 3/4".....	per doz.	.30
ZX2480	Magneto Rotor - Includes Rotor Shaft, Magneto, Lamination Assembly, Rotor Die Casting, Rotor Pinion #F5952, Rotor Pinion Pin #F2533 and Rotor Pinion Snap Ring #A1498E.....	1	8.15
C2492	Inner Retainer Washer.....	1 per doz.	.35
A2492A	Outer Retainer Washer.....	1	.10
C2493	Bearing Insulating Washer.....	2 per doz.	.20
H2498	End Cap to Frame Gasket.....	1	.10
H2514	Primary Ground Switch Strip.....	1	.15
A2514H	Ground Switch Group - Radio Shielded - Includes #B7355, #G2457A, #D2458, #H2514, #B6018, #6S12G, #6R1, #6LWL.....	1	.55
6S12G	Ground Screw - #6-32 x 3/4".....	1 per doz.	.10

PART NO.	DESCRIPTION	NO. USED	PRICE EACH
6N1	Ground Screw Nut - #6-32.....	1	per doz. .15
6LW1	Ground Screw Lockwasher - #6.....	1	per doz. .10
F2533	Rotor Pinion Pin.....	1	per doz. .35
AX2563	Impulse Coupling Hub Assembly - Type U2-CCW (Lag Angle must be Specified) - Includes Hub Plate, Hub Shaft Member, Hub Pawl, Hub Pawl Rivet, Hub Pawl Washer.....	1	3.30
RX2563C	Impulse Coupling - Complete - Type UBL4 - CCW - Includes Coupling Hub Assembly, Coupling Drive Spring, Coupling Shell.....	1	5.90
D2565	Coupling Drive Spring.....	1	.35
D2568	Coupling Pawl Stop Pin.....	1	.20
M2570	Coupling Nut.....	1	.40
C2565	Distributor Shaft Flat Washer.....	2	per doz. .20
C2733	Rotor Shaft Thrust Bearing Shim.....	2	.20
A2735	Cable Outlet Nut.....	4	.20
A2735A	Ground Cable Outlet Nut.....	1	.15
E2736	Primary Lead Wire Tube.....	1	.15
A2744A	Ground Cable Outlet Bushing.....	1	.40
M2765	Distributor Rotor - Includes Rotor Contact Insert....	1	.65
B2824	Rotor Bearing Insulating Strip.....	1	per doz. .15
G3861	Bearing Seal Rubber Washer.....	1	.15
B3969	Ground Cable Terminal.....	1	.35
B3969C	Ground Cable Terminal Assembly - Includes #B1077, #A1166, #A2735A, #B3969, #A6018, #A2744A.....	1	1.10
A1361	Lead Wire Terminal - #8 Screw.....	2	per doz. .35
N4631	Bearing and Breaker Support Plate - Includes Bearing and Breaker Plate, Breaker Arm Fulcrum Pin, Rotor Shaft Oilite Bearing #B5950A and Distributor Shaft Bearing #5950C.....	1	2.50
856G	Bearing and Breaker Plate Screw - #8-32 x 3/8".....	4	per doz. .10
A5931A	Impulse Coupling Nut Lockwire.....	1	per doz. .20
Q5939	Distributor Shaft & Gear Assembly - Includes Distributor Shaft & Gear.....	1	1.65
C5949	Rotor Ball Bearing - Drive End.....	1	1.50
B5950A	Rotor Sleeve Bearing - Oilite.....	1	.35
D5950C	Distributor Sleeve Bearing - Oilite.....	1	.25
F5952	Rotor Pinion.....	1	.40
DX5957	Impulse Coupling Shell - Type UBL4.....	1	2.30
A5961	Ventilating Screen Rivet.....	1	.10
B5969	Stationary Contact Bracket Washer.....	1	per doz. .10
A6018	Primary Ground Insulating Washer.....	1	per doz. .10
A6030	Ventilating Screen Washer.....	6	.10
A6032A	Ventilating Screen.....	3	.10
A6032AC	Ventilating Screen Group - Includes #A6032A (3), #A6030 (6), #A5961 (3), #A2448 (3).....	3	.25
OK16	Complete Gasket Kit - Includes #A2492A (1), #H2498 (1), #G3861 (1).....	1	.25

PREPARATION

After installing the plant in the proper location and on a base follow these instructions for putting it into operation.

PLANT

Check all fittings and bolts. Tighten any mechanical or electrical connections necessary. Visually inspect all parts for damage and replace if needed.

EXHAUST SYSTEM

An automotive type muffler and flexible exhaust tube are included in the accessories. This tubing is long enough to conduct exhaust gases from the plant to the outdoors providing it is within 36" from the wall. The muffler is then connected to the outside end of the tubing. The tubing should be shielded where it passes through the wall. A 4" or 6" hole should be cut and a piece of sheet metal fastened over the hole on both sides of the wall. The tubing is then centered so that it passes through the center of the hole.

If at any time the exhaust line rises above the exhaust outlet of the plant a water trap should be installed. This can consist of a pipe tee in the exhaust line. A capped nipple is screwed into the center of the tee so that it is hanging down. The cap must be unscrewed periodically to remove any condensation collected.

If it is necessary to install a long exhaust line rigid tubing may be used, but the flexible tubing should be connected between it and the plant. For every additional six feet of exhaust length increase the size of the tubing 1/2". It is preferable to keep the tubing as short as possible.

The muffler should be suspended so that it discharges the gases downward so that rain or snow will not enter it. It must be shielded against the elements and so that it cannot be touched accidentally or otherwise one can be severely burned. If desired an underground muffler may be installed.

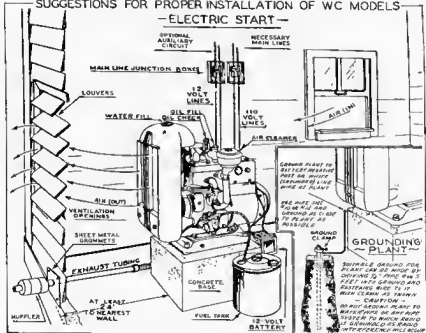
FUEL SYSTEM

Fuel is supplied either by gravity from a tank mounted on the plant or pumped to the carburetor from a remote tank by a mechanical fuel pump mounted on the engine. Check all fuel line connections and tighten if necessary. Fill the tank with gasoline. An underground or separate larger fuel supply may be used for more permanent installations.

GROUNDING

The plant must be grounded. This can be done by driving a 1/2" pipe or conduit four or five feet into the ground fairly close to the plant. It is then connected by an approved type ground clamp with a #10 or #12 wire to the battery negative post or white main line wire at the plant. Do not ground to the plant itself or to any ground used by a radio system.

SUGGESTIONS FOR PROPER INSTALLATION OF WC MODELS —ELECTRIC START—



PROPER INSTALLATION MEANS ADDED YEARS OF SATISFACTORY SERVICE

PROPER INSTALLATION

A properly installed electric plant for permanent installation should be set up in a wall ventilated room of ample size, (at least 10' x 10'). Install plant at least 24" from any wall.

Rubber Shock Absorbing Bushings furnished with the unit should be set under the Plant to reduce vibration. **CAUTION** Shock Absorbing value of rubber bushings will be lost if bolted down too tightly. Plant will stay in place of its own weight.

CAUTION - All exhaust connections must be tight, as leakage of exhaust fumes which contain poisonous monoxide gas is **VERY DANGEROUS**. If Plant must be located in basement, install a water trap in the exhaust line or pipe to take care of condensation. Do not run an exhaust pipe further than twenty (20) feet.

PROPER VENTILATION

Any engine must have a free circulation of air while operating. Provide at least two openings for ventilation (one for incoming and one for outgoing air).

DO NOT OPERATE YOUR PLANT IN A CLOSED ROOM AT ANY TIME.

Openings or ventilators should be at least 18" x 18" with louvers. Cover ventilators or openings with large mesh screen.

If Plant must be located in basement be sure to provide extra cellar openings to take care of air circulation needed by Plant. Basement locations are not recommended because of dampness and poor air circulation. The slight mechanical noise from the unit is also usually objectionable in basement installations. Exhaust connections must be tight and checked often - **EXHAUST GASES ARE POISONOUS.**

PREPARATION

LUBRICATION

After the plant has been properly installed, the crankcase should be filled with 6 quarts of S.A.E. 20 oil, if the engine is operating at a temperature above 50 degrees Fahrenheit; S.A.E. 10 oil if the plant is operating in a temperature below 50 degrees Fahrenheit.

The oil level is indicated by the float gauge on top of the cylinder block. The oil level should be maintained between the full and low mark, and never allowed to drop to the danger mark. The oil level should be checked daily until the operator is familiar with the normal oil consumption of the engine and as frequently thereafter as is necessary, to insure that the oil level never drops below the major mark on the gauge.

Place several drops of light machine oil on (1) the joints of the linkage between carburetor and governor (2) the throttle bearings. Remove the cover and inside portion of the air cleaner. Fill the bath of the cleaner with crankcase oil to the level indicated.

The fan hub is lubricated with regular engine oil. Remove the plug between the V belt sheave and the fan blade assembly. Fill to the point of overflowing and replace the plug so that it is tight.

COOLING SYSTEM

The cooling system of this plant is of the thermal syphon type depending on the natural principle of water rising when it is heated. The radiator and plant must be kept clean at all times and only clean water used in the system. The capacity is 9 quarts.

Check all hose and block connections and tighten them if necessary. Then fill radiator with clean, alkali free water. Rain water may be used - never salt or alkali water.

Test the fan belt tension. It should be such that one side of the belt can be moved inward or outward about 3/4" easily. To adjust, loosen the cap screw holding the fan support bracket to the water outlet fitting on top of the cylinder. Then move the entire bracket upward to increase the tension, downward to decrease the tension.

The water can be drained from the entire cooling system by opening the petcock at the bottom of the radiator support casting.

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